" Just a Wee Dot Like Doris "

by " L.B.S.C."

THE above paraphrase of a famous Scottish comedian's well-known song, will introduce the little sister to " Doris," the L.M.S. 3-1/2in. gauge class 5 engine, about which I promised, by kind permission of our friend the K.B.P. to give a few details. Having had requests from plenty of beginners and inexperienced workers who are not only sadly lacking in equipment, but also space for an outdoor line, to describe a simple type of engine which can be easily and cheaply built, and will run on an indoor line, I have tried to kill all the birds with one shot. As far as general outline goes, " Dot " is a faithful copy of her big sisters, bearing the proportions and general appearance of the L.M.S. class 5's ; but her "works " are simplified absolutely to rockbottom, and to the minimum necessary for efficiency. A " baby " lathe. a few hand tools,. and a one-pint blowlamp or small gas blowpipe, are all that will be needed, as long as the operator has the average amount of what is known as "common savvy." The cost of the few castings and bits of material needed, should be within the capacity of anybody's finances ; and if the builder has any young hopefuls who are mechanically minded, the little engine will bring joy to their hearts, for it will not only pull about twenty coaches, but will give them a ride. That is, of course, provided that the kiddies can be persuaded to sit still on a small flat car-the hardest job of all !

Specification in Brief

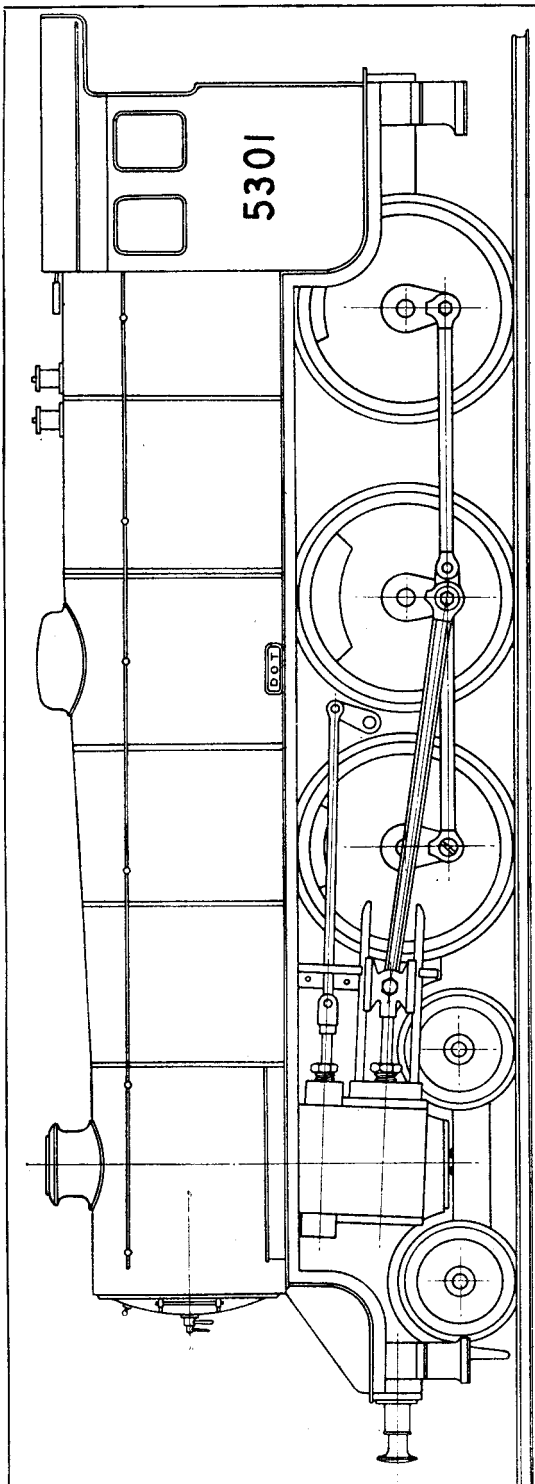
" Dot's " frames are nearly all straight lines ; one evening's work, easily. No hornbacks are needed, the axleboxes working directly in the frame slots, with hornstavs made from brass angle. The leading bogie is centrally-sprung, and no turning is needed for the axles. The cylinders have-slide valves, which are operated by loose eccentric gear, the outside rocking lever and the long valve rod taking the place of the full Walschaerts gear ; but if any reader with the necessary experience wishes to fit the full Walschaerts gear, all he has to do is to refer to the drawings-of " Doris's " valve-gear (the blueprint obtainable from our offices would be of great assistance) and make the parts exactly half-size. Don't forget to reverse the connections at the top of the combination lever, also to fit the return crank to lead the main crank ; otherwise the engine will back up when vou nut the lever in forward position. But for an indoor " scenic " railway, you can't beat the loose eccentric gear. If set to cut off at about 50 per cent., the engine will haul a long train on a mere crack of throttle, and "keep on keeping on" whilst any water is left in the boiler. and any spirit in the burners.

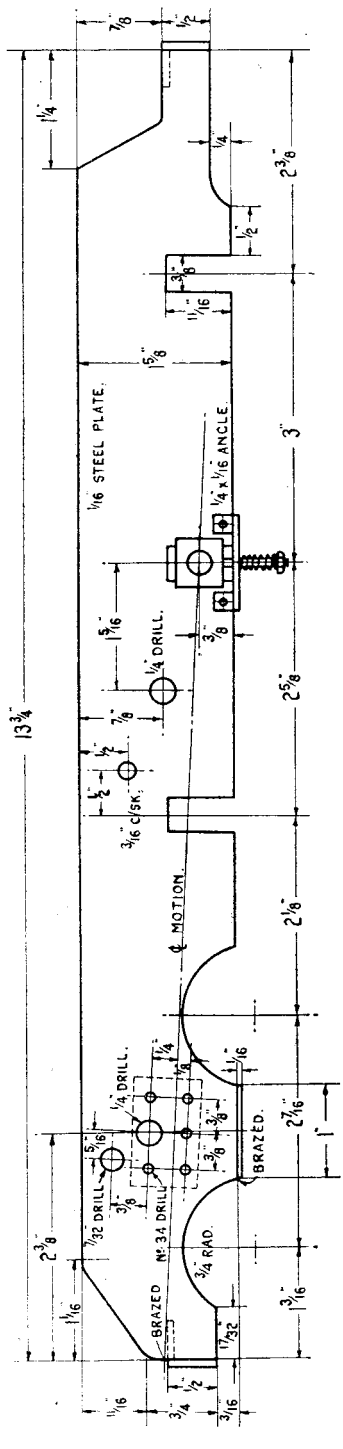
The boiler is of the simple water-tube type, with a copper-tube barrel and three Averill-type water tubes, inside a casing which can be made up from thin sheet steel or iron. Even tin would do ; and thereby hangs a good laugh. A follower of these notes says that he has a large spam can, which once contained a goodly portion of that well-known wartime delicacy [?] and being a bit of a wag, suggests building a gauge "1" edition of the class of engine known on the Southern Region as " spam cans," utilising the metal of the actual spam can for the boiler casing ; so the locomotive would be a spam can in fact as well as name !! Incidentally, joking apart, it would be a jolly good wheeze, for this reason ; the boiler casing of the full-sized " spam can," reproduced on the little one, could be made to serve as the outer case of the water-tube boiler. It could be lined with asbestos millboard, to keep in the heat, and still leave plenty of room for a fair-sized inner barrel. If fitted with the same cylinders and motion that I am specifying for " Dot," the " spam-can-ette " would be a most efficient engine.

" Dot's " boiler is fired by a spirit lamp, supplied with " liquid poison-gas " from a sump, which is automatically kept filled to correct level from a tank in the tender. The fittings are cut to the bare minimum; no water-gauge is needed, as the spirit flames cannot hurt the boiler even if run dry. The boiler is fed from a hand pump in the tender, a few strokes of which everv five minutes or so. are sufficient to maintain a-working level. The tender itself is just a half-size copy of the 3-1/2in. gauge tender, but need not be sprung, and is of simpler construction. Now I'll just briefly run through the sequence of operations ; there- isn't any need to waste time and space going into details, because the actual machining and fitting work is similar to that being detailed for " Tich," and also for the other locomotives recently described in full, so here we go.

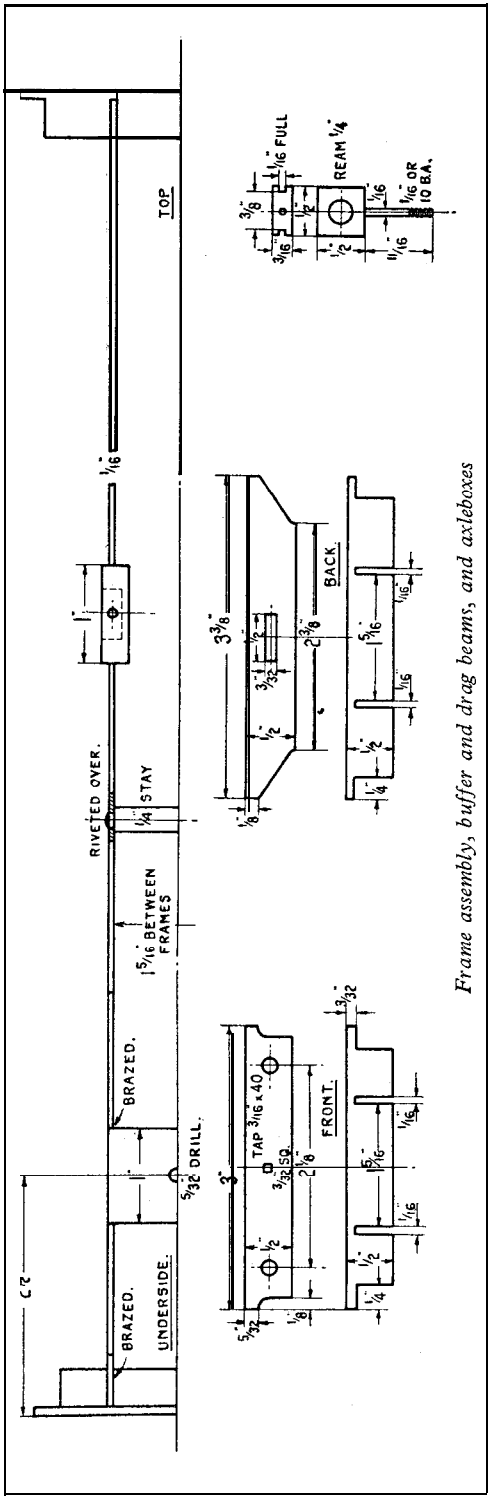
Frame Assembly

The main frames are cut from 1/16in. or 16-gauge blue steel or galvanised iron, all holes being drilled whilst the plates are riveted together for cutting to shape. The buffer and drag beams are made from 1/2in. by 3/32-angle ; brass or steel, it doesn't matter which. Note they are different lengths and shapes. The frames are stiffened up by a rod stay turned from 1/4in. round steel, 1-5/16 in. between shoulders ; and if this is put in before the frames are attached to the buffer and drag beams, it will hold the lot securely whilst the frames are brazed or silver-soldered into the slots. Braze if steel beams are used ; silver-solder if brass. The bogie bolster, made from 16-gauge steel, or same material as frames. is tied in uosition with thin iron wire. and braze-d or silver-soldered at the same heating ; alternatively, it can be bent up each side to form a flange to go between frames, and riveted in position with 1/16in. rivets. It is quite possible that our advertisers may supply -castings for





Outline and frames for Gauge "1" "Black Stanier"



Frame assembly, buffer and drag beams, and axleboxes

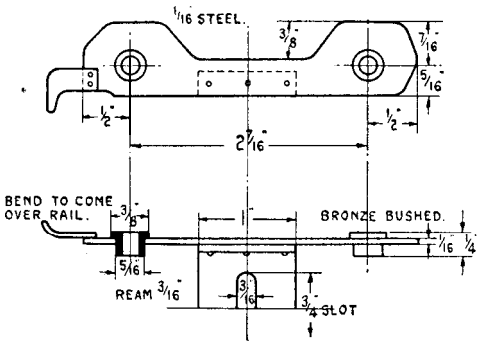
beams, complete with fixing lugs, and a bolster complete with pin. If so, I advise their use, to save time. For detailed instructions for cutting out and erecting frames, see notes about "Tich."

Running Gear

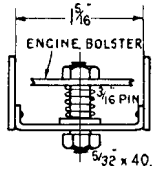
The axleboxes are bits of 3/16in. brass 1/2 in. square, grooved both sides to slide in frame slots, and drilled 1/4 in. for axles. The hornstays are 1-in. lengths of 1/4in. by 1/16in. angle brass, one of the angles being filed away at the centre, to clear the axlebox in lowest position. The spring pins are 1/16in. silver-steel, or 16-gauge spoke wire. Fit boxes first, then rivet on the hornstays, drill the spring-pin hole in middle of same, then jam each box up against the stay, and drill and tap it for the pin, through the hole in the stay. Then there is no chance of the pins binding. Springs are 22-gauge wire, held by commercial nuts and washers.

The wheels, axles, coupling-rod pins, eccentrics and stop collars, are all turned and fitted exactly as described for "Tich," but to the sizes given in the accompanying illustrations. Be careful with the quartering of the wheels, on a six-coupled engine. A couple of short lengths of 5/16in. by1/16in. strip metal, drilled to represent coupling rods, are of great assistance in getting the pins exactly right, and the wheels to turn freely without binding. Note that the driving and trailing crankpins are not reduced where they enter the wheel bosses ; leaving them parallel, saves time and trouble. Put a brass nut over the thread to protect it whilst pressing in. Leave 5/16 in. of the driving pin projecting from the wheel boss, and 9/64 in. of the trailing pin. With the axleboxes blocked up to running position-that is,with the axle centres 3/8 in. from bottom of frames-the wheels should turn freely without binding, or being unduly slack anywhere, when the dummy coupling-rods are on the pins. However, don't press the second driving wheel right home on the axle until the eccentric sheaves and stop collars are fitted ; drawings of these will be given next week, all being well, along with other details. I don't reckon anybody will get as far as the wheel job in one week !

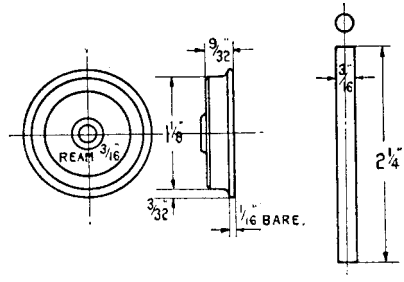
To save time, I might as well deal with the proper coupling-rods right away. They are cut from 1/8in. by 3/8in flat mild steel, either by milling or sawing and filing, as described for the bigger engine. Instead of a fork-and-tongue knuckle joint, an interlocked pin-drilled joint will do well in this small size ; but the pin must be screwed into one half of the rod. Simply pin-drill half of the thickness of each boss, and file off any bits of metal which project beyond the recess, so that the two halves interlock, as shown in the section. Tap the hole in one half 3/32 in. or 7 B.A., and screw in a bit of 3/32-in. silver-steel. Drill the other half No. 41 and countersink it. snip off the pin to length, and rivet over both sides, leaving the knuckle just free enough to move when the engine runs over a rough bit of road, or through switch points and crossing frogs. There is no need to bush the coupling-rod bosses. If they wear much, which they shouldn't do, even after considerable service, they can be opened out and bushed when they become slack



Left-Bogie details



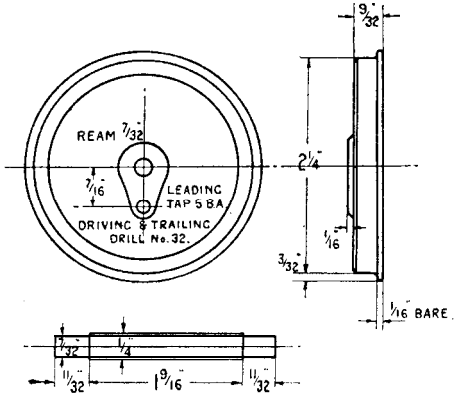
Below-Bogie wheels and axles



enough to warrant it. The leading boss on each side is pin-drilled *7/32* in. for half its thickness-see section-and the crankpin has a flat head to fit the recess. This pin is screwed into the wheel boss, instead of being pressed in.

Leading Bogie

The bogie is another kiddy's practice job. The side frames of it are cut from 16-gauge material, same as engine frames. They are connected by a 16-gauge sheet metal centre piece I in. wide and 1-5/16 in. long, with a 1/4in. flange bent up each side, for riveting to the side frames. Alternatively you could, if desired, simply braze a flat plate across the bottom. Whichever plate is fitted, needs a slot 3/16 in. full wide, and 3/4 in. long, cut in it for the bogie pin. This is a piece of 3/16in. round mild steel I in. long, reduced and screwed 5/32 in. by 40 for *1/4* in. length at each end. One end goes through the hole in the bolster on the engine frame and is secured by a nut above it. When the bogie is complete, the other end goes through the slot in the centre piece, with a spring and washer between, and a nut at the bottom, as shown in the cross-section. It is also quite on the cards, that our advertisers may not only supply cast bolsters with pin complete, which only need turning and facing, but also cast centre pieces, with the slot already in, and which only need smoothing off at the sides, before screwing the frame plates to them. You might 'even be able to get the side frames and centre piece all cast in one (like the pony truck for the 3-1/2in gauge " Bantam Cock ") and it would only need drilling for the axles ; a real " time-saver " !



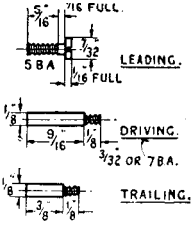
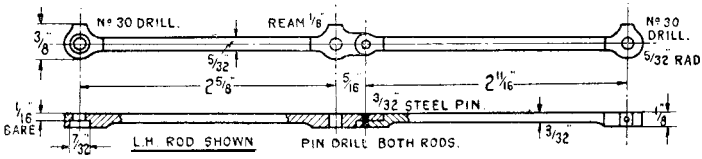


Plate frames will need little bronze bushes, turned from 3/8in. round rod as per illustration, pressed into 5/16in. holes in the bogie frames. These take the place of the conventional axleboxes, and are O.K. in this size of locomotive, as the central spring provides the necessary flexibility. The wheels are 1-1/8in. diameter on tread, the other dimensions being given in the drawing. The axles need no turning whatever, being merely 2-1/4in. lengths of 3/16in. round mild-steel. *Pres s* one wheel on each axle, poke the axle through the bushes, and press on the other wheel, keeping

Above-Coupled wheels, axles and crankpins

Right-Coupling-rods



the flange backs 1-9/16 in. apart. The guard-irons can either be cut out separately and riveted on, or cut in one piece with the bogie frames. Bend them outwards, to come over the railheads. Next items, cylinders and valve gear.

Locomotive Details on Other Jobs

Scarcely a week passes without a query coming to hand, asking if such-and-such a component, or detail, or method of construction which I have described in these notes, can be adapted to some other use. Most of them are quite O.K. and straightforward, and easily dealt with; but now and then I get either a real teaser, or one which goes from the sublime to the ridiculous. For example, somebody wanted to know what modifications, if any, he would have to make to one of my injectors, to make it operate ***under water,*** like a " drowned " hand-pump in a tender tank! Maybe a few words on the subject, may save time for both prospective inauirers and mvself.

The locomotive boilers I have described, will do for anything needing a good supply of dry steam, provided that the boiler can be accommodated in the space available. My firebox and tube arrangements will do for any traction engine, portable, semi-portable, undertype, or stationary boiler, and in most cases the full superheating arrangements can be used as well. Several of my wide firebox locomotive-type boilers have been used for wide-beam steamers, such as small steam tugs, launches, and similar craft. We don't often hear of coal-fired boilers being adopted for miniature marine use, yet I don't know whv it should be so. and have often wondered why our steamer friends seem to fight shy of coal-firing. The boiler of a 2-1/2in. gauge " Atlantic " engine, for instance, when in good fettle, will supply enough steam to haul a load equal to about 30 coaches, for 20 minutes or so at a time, without touching the fire. I don't know of any marine-type blowlamp that will run as long as that, without attention of some sort ; also I have yet to make the acquaintance of a blowlamp which will burn as quietly as a coal fire! The loco-type boiler could be fired through a chute; and with good quality coal, could run an indefinite time without trouble, noise, nor fuss.

One of the " Maid of Kent " type outside cylinders, with half the valve-gear, would be the berries for a powerful single-cylinder stationary engine ; the complete- " works " of an inside-cylinder job, with motion complete, mounted up on 'end, would make a fine twin-cylinder vertical, or even a launch or tugboat engine. As a matter of fact Mr. Stait, the father of Dick and Allan of that ilk, who run a little " 0 "-gauge scenic railway at South Cemey (recollect the story of " Molly " and " Toots," the " Mollyette " sisters ?) built a fine marine engine using two " Mollyette " cylinders, with motion complete, side by side, arranged vertically. Among all the cylinders and valve-gear arrangements I have described, it should not be difficult to find one or another, to suit any job within reason. With my recommended valves, ports, setting, etc., there would be no question of losing efficiency.

Pumps and injectors can be selected, from those I have described, to feed any type of boiler within reason ; whilst the boiler fittings used on my locomonves are equally suitable for any type of boiler-vertical, horizontal or marine. A fine present for a mechanically-minded kiddy would be a little steam wagon, with a working steering, so that it would run on the floor, around a room. A small plain spirit-fired " pot " boiler in front, the works of " Mollyette " under the footboards, driving the rear axle through three or four gears retrieved from a discarded or broken clock, a little simple " coachbuilding " to make a realistic wagon body, and the child would have something that couldn't be purchased in any toyshop for love nor money, especially as things are now!

An Electric Clock with a Semi-free Balance

(Continued from page 600)

" housing," clamping the two items together to form a template. Remove job from lathe and clear all burrs, etc. Insert three short 12-B.A. screws and again clamp the two items (cover and housing) together. Rechuck in lathe and polish edges of both flanges as one.

Procure a piece-of 5/64-in. glass and roughly reduce to a working diameter by " nibbling " and grinding, then proceed as follows :-

(a) Mount a short length of hardwood in the lathe chuck ; face off and-turn a recess sufficiently large to accommodate the rough disc.

(b) With a stick of adhesive (shellac or similar) smear all surfaces of the recess, after warming the job with a spirit lamp ; also slightly heat the glass disc.

(c) Press the disc " hard in," applying a gentle heat in the meantime. When cool, turn the wood away sufficiently to expose the edge.

(d) Turn outside diameter to size, using a coarse grade carborundum slip (or diamond tool, if available) held in slide rest ; do not make it fit too tightly into its spigot.

(e) Remove from lathe by gently heating and clean in methylated spirit or other solvent.

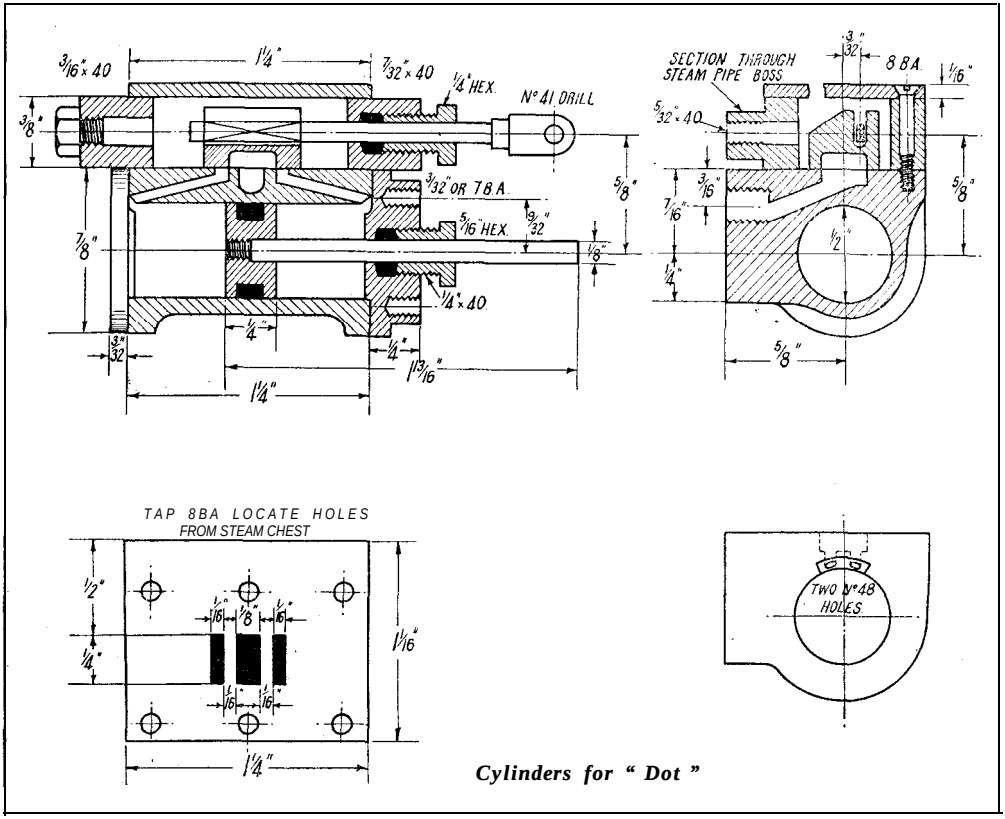
(To ***be continued)***

Cylinders for the Wee " Dot " like "Doris "

by " L.B.S.C."

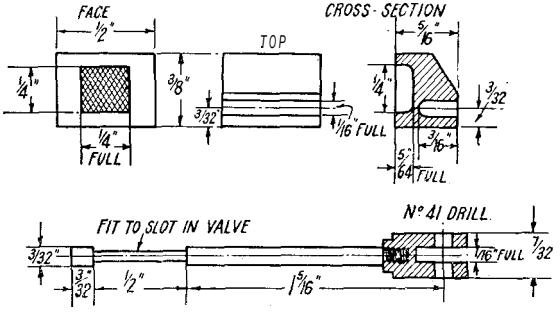
IF anybody cares to tackle a pair of proper piston-valve cylinders for " Doris's " baby sister, all they have to do, is to halve the dimensions of the 3-1/2in. gauge pair, and go right ahead. If they prefer slide valves, they will find all they need in the way of dimensions, in the accompanying illustrations. I used a similar pair on a gauge " I "engine of the 2-6-0 type, which I built for an old fellow-conspirator of the railway, now alas ! on the other side of the Great Divide. Thev were bored out to a shade over 9/16 in., as big as the castings would allow ; and the engine ran away with a twelve-year-old boy, on the steam generated by ***six*** 1/4in. " poison-gas " wicks. The boiler was smaller than that I am specifying for " Dot." Although I have shown the bores as 1/2 in. in the drawings, it is quite all right to bore them a little larger if you so desire. As long as the chimney liner and blast nozzle are O.K., so as to ***get*** enough air through the firebox, to ensure complete combustion-" take all the poison out of the gas," as my lamented friend used to say-there won't be any steaming trouble. Better results still, could be obtained by fitting one of my small oil burners, blueprints of which are now available from our offices. Cylinders of 5/8 in. bore could be used, if the boiler is fired by an oil burner in good fettle.

The general instructions for machining and fitting the cylinders on the 3-1/2in. gauge engine, can be applied to the smaller one, making variations where necessary. These small castings, however, need not necessarily be set up on an angle-plate for boring ; if your four-jaw chuck will hold them, use that. The modus operandi is practically the same. If the core-hole in the casting is in the right place, just set it to run truly ; then face the end flange, bore and ream, and finish the other end on a stub mandrel. If the core-hole is out of truth, mark a circle on the end, and set it to a scribing-block needle, with the scribing block standing on the lathe bed or saddle. If beginners haven't a scribing block, and finances are well below par, make one up ; it is easy enough. You would have laughed to see young Curly's first attempt at a scribing



Cylinders for " Dot "

block. The base was a small " press-in " type tin lid ; the spindle was a bit of stiff wire bent at right angles at the bottom, and soldered to the lid, the flange of which rested on the lathe bed or whatever was being used. Mother's flat iron made a swell " surface plate "! The needle was one of mother's hat-pins. I found out how to make the block that carries the needle, from gazing at a proper scribing block in a tool-shop window ; but mine was very much modified, as I used an old bolt with a wing nut. A hole close to the bolt head, through which rhe wire spindle passed, and was clamped by the wing nut, provided height adjustment, while the hat-pin was clamped between two washers, placed between the wing nut and the spindle. " Where there's a will, there's a way," and " necessity is the mother of invention," were two sayings which might have been specially inspired by young Curly's antics. In later years, I made a good scribing block with a locomotive wheel for a base ; and also made vee-blocks by riveting two pieces of sheet metal together and filing to shape, like



Slide-valve and spindle

you would do to cut out frames, and then fixing them (after filing a vee in one edge) at 1/2 in. apart, with three little spacers. Incidentally, I wrote to a certain party and mentioned these wheezes. He promptly wrote an article in which he claimed the ideas as his own ; such is life ! Many of the improvements in small locomotive construction, as described in these notes, have been -and are still being-exploited commercially ; not that it worries me in the least, but as our 'Oxton friend, Bert Smiff would remark, " Us blokes ain't above a bit o' scroungin', but we're 'onest enuff to say where we got the goods ! " Nuff sed.

Sometimes these small cylinders are cast solid. In that case, all you do is to mark out one end and centre-pop the middle of the location of bore ; chuck in the four-jaw? run the tailstock up to the casting, and adjust jaws until the pop-mark is true with the tailstock centre. Alternatively, you can hold the casting against the tailstock centre, with the point in the pop-mark, and close the chuck jaws down on to it. Put a 1/8in. pilot hole through first, then drill 7/16 in., take a cut through with a boring tool, in case the drill has run out of truth, and finally ream.

The casting can be held crosswise in the chuck, for facing off the port face and bolting face ; but put a piece of I6-gauge or thicker metal, such as soft brass or aluminium, between the machined ends and the chuck jaws. Set with a try-square, same as if you had the job on an angle-plate. The ports may be end-milled by one of the several methods I have previously described, or be hand-cut wirh a small chisel ; if end-milled? it doesn't matter a bean if the ends are left semlcircular. The passageways should be drilled by hand, the casting being held in the bench vice, on the slant, so that if the brace is held level, it will direct the drill into the side of the port, and avoid breaking through the port face.

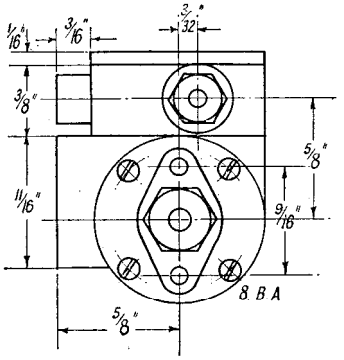
Covers, Pistons and Glands

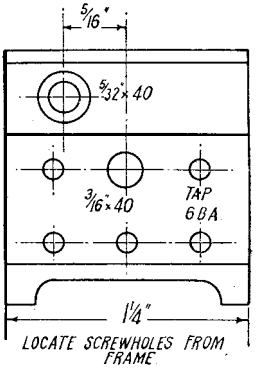
The cylinder covers and pistons are machined and fitted, same as described for the 3-1/2in. gauge job. After mounting the rough-turned pistons on their rods, hold the rods in a split-bush in the three-jaw, if you haven't a collet chuck, for finish-turning the pistons to size. Somebody I know, hadn't a three-jaw, so he turned the lot between centres. If the lathe is a very small one, and the veracity of the chuck is nothing to write home about, it might be advisable to follow suit. My first tiny lathe didn't have any three-jaw, only a few brass chucks of the kind that unofficial history tells us, were used on the lathe in the engine-room of Noah's Ark ; but I seemed to get on all right by aid of a few spots of improvisation. I didn't even have a slide-rest ; but, as followers of rhese notes who have read my childhood reminiscences will recollect, the abnormal physical strength which I possessed when a child, enabled me to hold a hand-tool perfectlv rigid for the few simple jobs that I carried through. Incidentally, I'm not exactly a weakling now ; a few days ago, when a friend from Ashford saw me pick up a heavy tray of castings by the edge, with one hand, he said in surprise, " Curly, you haven't half got a strong wrist ! " I might add, it takes the two of them to carry the 2-6-6-4 Mallet " Annabel " down a flight of stairs, and up a sloping garden path to our little railway.

Beginners note the following : make a dummy plug for the stuffing-box in the back cylinder cover. Just chuck a bit of 1/4in. brass rod in three-jaw? face the end, screw for about 1/4 in. length with 1/4 in. by 40 die in tailstock holder, and part off a slice about 1/8 in. thick. The centre of this will be automatically marked by the facing tool. Scribe a line right down the middle of the oval boss, cutting through the centre of the plug, which should be temporarily screwed into the stuffing-box. At 9/32 in. above and below centre, make two centre-dots ; drill No. 48 and tap 3/32 in. or 7 B.A., using drilling-machine or lathe — ***not*** by hand. These holes are for the guide bars, and if rhey are not dead square with the cvlinder cover, the bars won't line up with the piston rod.

Drill the four No. 43 screw-holes in the cylinder cover, and put the cover on the end of the cylinder. Lay the cylinder, bolting face down, on the lathe bed ; set your scribing-block needle to centre of the dummy plug, and adjust

the cover until the centres of the guide-bar holes are at the same height. Put a cramp over the cylinder and cover, to prevent the latter shifting, then run the 43 drill through the holes, making countersinks on the cylinder flange ; follow with No. 51 and tap 8 B.A. The piston-rod glands





Back view and bolting face of R.H. cylinder

are turned from 5/16in. hexagon rod, bronze or gunmetal for preference.

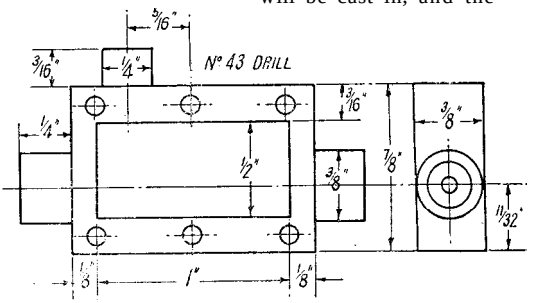
Steamchests

Castings for the steamchest will have the bosses cast on. Chuck one boss in the three-jaw, and set the other one to run truly ; centre it with a centre-drill in the tailstock chuck. Run up the back centre to support it whilst you turn the outside,. and face the end of the steamchest ; then drill it through with No. 41 drill, and open out and tan 7/32 in. bv 40 for the gland. Reverse in chuck, repeat operations for 'the other boss, but drill it right through with 5/32 in. or No. 22 drill, and tap 3/16 in. by 40 for a plug, which is made from a bit of 1/4in. hexagon brass rod. Use bronze or gunmetal rod, if possible, for the gland. The steam pipe boss at the side, need not be turned ; just smooth off the end with a file, centre, drill No. 30, and tap 5/32 in. by 40. Both sides or contact faces of the steamchest can be machined off with the casting held in a four-jaw chuck.

Drill the screw-holes ; then cut out a piece of 1/16in. sheet brass for the cover-plate, 1-1/4 in. long and 7/8 in. wide. Drill this by clamping the steamchest to it, and using the screw-holes in same as guide. Then clamp the steamchest to the port face, and make countersinks on same by running the No. 43 drill through the screw-holes. Remove steamchest, drill countersinks No. 51 and tap 8 B.A. Use 8-B.A. countersunk steel screws to hold the lot together, countersinking the holes in the steamchest cover-plate to match.

Valves and Spindles

The slide valves may be castings, or cut from a bit of bronze or gunmetal bar, either 3/8 in. by 5/16 in. section, or 3/8 in. square. Hold it in four-jaw and part off the two lengths to size. The slots for valve spindles can be best cut, if a regular milling-machine isn't available, by clamping the valve in a machine-vice-or improvisation thereof, as described in the Beginners' Corner a little while ago-and running under a 1/16 in. wide saw-type milling cutter on a spindle between centres. It may also be cut on a shaper or planer, by aid of a 1/16in. parting tool in the clapper box. Alternatively, a No. 51 hole could be drilled lonrritudinallv through the valve, at the location of the bottom of the slot ; a saw-cut made from the top of the valve, down to the hole, by aid of two saw-blades put together in the frame, and the sides then smoothed with a key-cutter's warding file. Also a 16-gauge slotting blade in that most handy gadget, the Eclipse " 4s " tool, would do the job in two wags of a dog's tail. If castings are used, the exhaust cavity will be cast in, and the



Steamchest

valve will be externally to the shape shown. If cut from solid, file off the corner of the valve (no need for " mike " measurements on that job, even by our old friend Inspector Meticulous. himself !), and form the cavity by making a countersink on the sliding face with a 1/4in. drill, and chipping it square by aid of a little chisel made from a bit of 1/4in. round or square silver-steel. If the length of the cutting edge equals the length of the cavity, you don't get any mouse-nibbled edges. Same applies to hand-cut ports.

The valve spindles are made from 1-3/4in. lengths of 3/32-in. rustless steel or bronze rod. One end has a few threads, 3/32 in. or 7 B.A. cut on it ; the other end is filed flat to fit in the slot in the back of the valve, starting at 3/32 in. from the end. I usually chuck the spindle in the three-jaw for screwing, then reverse it, and turn a couple of scratches with the point of a knife-tool, at the start and finish of the flattened portion. One of these (the one farthest from the end, naturally !) is placed level with the chuck jaws ; and with one of the jaws set to twelve o'clock, and the file held horizontally, a flat is formed. The same jaw is then turned around to six o'clock, and the other flat filed. The length of the flat is checked by applying the valve itself to the job.

The flats should fit the slots easily, but should not have any appreciable end movement, otherwise the valve setting will be faulty. The fork on the end of the spindle is made- the same as described for umpteen other engines, so needs no detailing. Use oiled paper, or 1/64-in. Hallite or similar jointing, between cylinder casting, covers, and steamchest joints ; pack piston and glands with graphited yarn, and Bob's your uncle as far as the cylinders are concerned. Next stage, guide bars, -crossheads, connecting-rods and valve-gear.

Beginners' Corner (contd.). Pump for "Tich"

We left off after finishing the pump barrel and valve-box, so now we need the top and bottom caps for the valve-box. The valves themselves are 5/32-in. balls. either rustless steel or phosphor-bronze. If you are using the former, drop one into the D-bitted end of the valve-box ; rest the other end on a block of lead, or something else that won't damage the faced end. Put a short bit of 3/16in. round brass rod on top of the ball, and give it just one sharp crack with a hammer. This takes the sharp arris off the edge of the reamed hole, and the ball thus forms its own watertight seating. If you are using bronze balls, form the seating as above, with a 5/32-in. cycle bearing ball ; *not* the bronze ball. The latter isn't nearly so hard as the steel ball, and the seating will cut a weeny groove in it, if you try to seat it direct. The bronze ball will seat watertight on a seating formed by a cycle ball of similar size.

Now take the distance from the top of the ball, to the top of the valve-box, with a depth gauge; Young Curly's depth gauge was one of mother's hat-pins stuckthrough a-tram ticket. You can make one by drilling a No. 41 hole through an inch or so of 3/16in. square brass rod, putting a 3/32-in. or 7-B.A. set-screw in the side, and using a piece of 3/32-in. silver-steel, about 3 in. long, for the sliding part. Put the rod across the top of the valve-box ; push the pin down until it touches the ball, and tighten the screw. You'll need this in a few minutes, all being well.

The top cover of the valve-box is in the form of a T, the stem screwing into the valve-box, and the two ends of the head carrying union screws for connecting to the boiler clack and the by-pass valve respectively. It can be made from a casting, or built up. If cast, it will look like a cross, as it will have a chucking piece on top. First, chuck in three-jaw by one side of the head, and set the other end to run truly, gently tapping with a lead hammer, or something else that won't damage the casting, until it doesn't wobble when the lathe is running. Then tighten the chuck. Face off the end carefully ; for nearly all facing jobs on small fittings, I use a square-ended tool, with the point nearest the chuck, ground off to an angle of about 30 deg. An ordinary knife-tool sometimes catches up and knocks the job clean out of the chuck, damaging the soft casting beyond recall. The tool above mentioned, never plays rhat trick, and is also useful for chamfering the corners of union nuts and similar fittings.

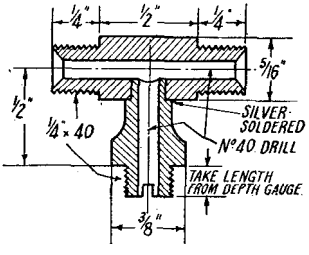
Centre the end, same as you centred the wheels, letting the centre-drill penetrate until it has sunk in far enough to leave a countersink which measures a full 3/16 in. across. Then turn the outside for 1/4in. length, to 1/4 in. diameter, using a knife-tool as when turning wheel seats, and screw it 1/4 in. by 40, with the die in tailstock holder. You obviously can't reverse the job in the chuck, to turn and screw the other end, as the chuck jaws would have to be tightened enough to ruin the threaded part ; so use a tapped bush. Chuck a short bit of 1/2in. round rod in three-jaw; any odd scrap, brass or steel, about 1/2 in. long, will do fine. Face the end. centre. drill right through with 1/32-in. drill, slightly countersunk the end with 1/4in. drill, tap 1/4 in. by 40, using the tailstock chuck to guide the tap, as previously described, and skim off any burr left from drilling and tapping. Don't remove from chuck, but screw the threaded end of the tee into it. The outer end will run quite truly. Give that end a dose of the same medicine as the first end ; and then drill right through it with a No. 40 drill, as shown in the section of the complete pump. Make a centre-pop opposite No. 1 jaw, on the bush, before taking it out of the chuck.

Now chuck the casting-by the spigot on top, provided for the purpose. Set the stem to run truly, as above. Face off the end ; centre, and drill it with a No. 40 drill until you break into the cross-hole at the top. The next bit is where you need the already-set depth gauge ; turn the stem to 1/4 in. diameter, to the same length as indicated by the projecting part of the depth gauge pin. Screw it 1/4 in. by 40, and then face just 1/32 in. off the end, to allow the ball that much lift. Finally, file two nicks across the end, with a thin flat file, so that when the ball rises off its seating on the forcing stroke of the pump, and seats against the hole, the water can get out through the nicks. An old friend forgot these nicks on one of his engines, and spent about a fortnight looking for the tight spot, error in valve-gear, etc., which he imagined was causing the wheels to lock as soon as the engine tried to make a start ! Cut off the chucking piece, and file away the stub, making the fitting as neat as possible ; then drop the ball in the valve-box, and screw the fitting home, with a touch of plumbers' jointing (" Boss White," or any similar preparation, sold at all ironmongery stores) on the threads ; but be careful not to get any inside the valve-box. The union screws should point fore-and-aft, as our nautical friends would remark ; see sectional drawing.

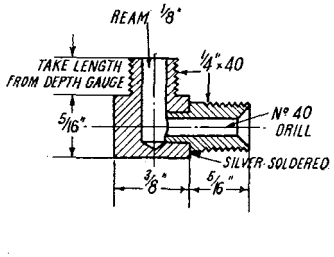
The bottom fitting is somewhat similarlv machined, but it has only one union screw, and the ball seats on the stem. The fitting will have two chucking pieces, so chuck in three-jaw by one of them ; set the other end to run truly, then face, centre, turn and screw it, exactly as described for the union ends of the tee above. Then drill halfway through it with No. 40 drill. Next, chuck by the other chucking piece, and set the end to run truly. Face off, centre, and drill down with No. 32 drill until you break into the hole already drilled ; see section of complete pump. Put a 1/8in. parallel reamer into this hole. as far as it will go : then carefully face off the end.

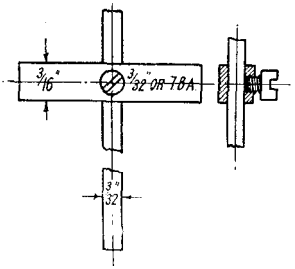
Turn the pump upside down, and drop a 5/32-in. ball into the lower part of the valve-box. Take the distance from the top of the ball, to

the end of the valve-box as before, and tighten the set-screw of the depth gauge. Now turn the stem of the fitting in the chuck, to 1/4 in. diameter, for a distance approximately 1/64 in. less than the length indicated by the gauge pin, and screw it 1/4 in. by 40. As the ball sinks into the seating a little, this will give the ball a shade over 1/32 in. total lift. Saw off both chucking pieces, and smooth the stubs away with a file ; put the ball (if steel) on the end of the stem, apply the brass



Built- up pump fittings



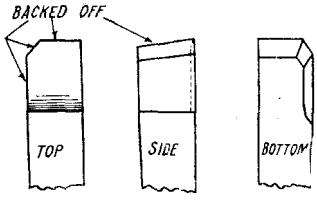


Simple depth gauge

rod to it, and give it a crack with a hammer as above. The fitting can be held in the bench vice for this job. Then drop the ball in the hole in the valve-box, and screw in the fitting, with the union screw pointing towards the pump barrel, as shown in the section of the complete pump.

Built-up Fittings

Instead of using castings, the top and bottom fittings may be built-up. For the top one, chuck a piece of 5/16in. round brass rod in the three-jaw. Face the end, centre deeply, and turn and screw it exactly as described for the casting ; part off at I in. from the end. Reverse in chuck, and serve the other end the same, drilling a No. 40



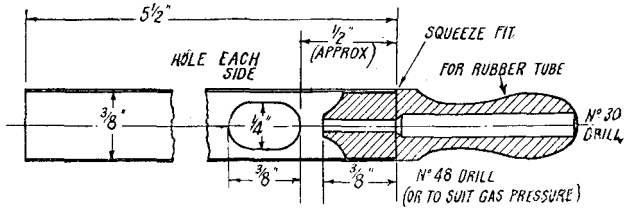
Facing and chamfering tool

hole clean through. Drill a 5/32-in. hole in the side, halfway along, breaking into the middle hole.

Chuck a piece of Q-in. brass rod in three-jaw ; face, centre, and drill down 3/4 in. depth with No. 40 drill. Face off the end until any countersinking has been removed ; then turn the end to 1/4 in. diameter, to 1/32 in. less than distance from top of ball to top of box, as indicated by the depth gauge. Screw 1/4 in. by 40, and part off at 5/8 in. from the end. Put the tapped bush in the chuck, with the centre-pop opposite No. I jaw, and screw the *fitting into it. Turn 1/16* in. of the end, to a tight fit in the side hole in the other piece ; then turn the rest to the shape shown m the illustration. Squeeze it in, and silver-solder the joint, afterwards cross-nicking it, same as the casting.

Silver-soldering Fittings

This is one of the easiest jobs going. I use " Easyflo " silver-solder in wire *form* (supplied commercially by Johnson-Matthey's) and the special flux that goes with it ; but best grade silver-solder cut in thin strips, with jewellers borax (powdered and mixed to a paste with water) does very well. You can use a little blowlamp, or a small gas blowpipe can be made in a few minutes from a bit of 3/8in. brass or copper tube, which is self-blowing. See illustration, which explains itself. A small tin lid with a few bits of small coke or asbestos cubes in it, makes a small forge ; it need not be bigger than a soap dish. Simply anoint the joint with the wet flux, blow to medium red, and touch the joint with the silver-solder wire or strip. It immediately melts and runs m. Don't use too much-it not only spoils the appearance, but is expensive. Quench out when it has cooled to black, in a drop of acid pickle in a jam jar. The acid pickle is



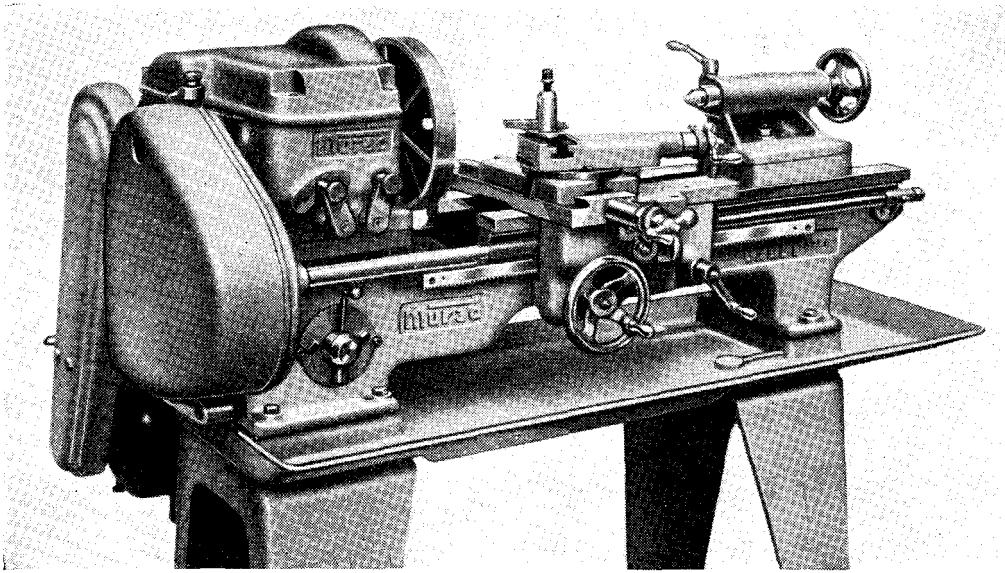
Simple self-blowing gas blowpipe

composed of I part commercial sulphuric acid to about 16 of water, or I part old accumulator acid to 4 of water. Let the fitting stay in for about ten minutes, then fisli it out, wash under the kitchen tap, wipe dry and clean up. For cleaning up, I use a circular wire brush on a spindle stuck in a taper hole in the end of my electric grinder ; but it does as well if held in the lathe chuck. Run the lathe as fast as possible without causing an earthquake.

The bottom fitting is easier still to build up. Simply chuck *a* bit of 3/8in. brass rod *in* three-jaw, and proceed to machine up the end exactly

(Continued on next page)

The Murad " Cadet" 4-in. Lathe



Messrs. Murad Developments Ltd., of Stocklade, Aylesbury, Bucks, have recently introduced a new 4-in. lathe which embodies several interesting features. It has a centre height of 4in., with a gap bed, admitting a maximum diameter of 11 in. in the gap, and maximum length of 18 in. between centres. The headstock has an all-geared drive, giving six speeds from 43 to 818 r.p.m. and the mandrel, which has a through bore of 13/16 in. with No. 3 Morse taper socket, runs in large-diameter, long white metal bearings. The standard set of change-wheels provides for cutting threads from 2-1/2 to 96 t.p.i., and saddle feeds from 0.400 to 0.0037.

A cast-iron stand is supplied, and also a cast tray, with machined seatings for the feet of the lathe, serving to increase its rigidity and further resist distortion. The electrical equipment consists of a 1/2 h.p. motor bolted to the back of the stand and driving the enclosed gear countershaft by vee-belt, also a built-in motor reversing switch below the headstock. Standard equipment includes driver plate, two centres, set of change gears, and necessary spanners ; extras include 8-in. faceplate, fixed and travelling steadies, independent and self-centring chucks, chasing dialj 4-way turret toolpost, and collet attachment. A long bed machine, taking 24 in. between centres, is also available to order.

" L.B.S.C."

(Continued ***from previous*** page)

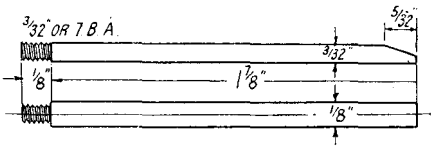
as described for the casting, when forming the ball seat. Part off at 5/16 in. from the shoulder, and drill a 5/32-in. hole in the side. Chuck a piece of 1/4in. round rod in the three-jaw ; face the end, centre deeply, and drill down to a full 1/2 in. depth with No. 40 drill. Screw the outside 1/4 in. by 40, for1/4 in. length, and part off at 3/8 in. from the end. Rechuck in the tapped bush ; turn about 3/32 in. of the end to a tight squeeze fit in the side hole of the other part. Squeeze it in, silver-solder it, pickle, wash and clean up. Seat a ball on the faced end, and assemble as previously explained.

May I beg your forgiveness for a small error in the notes in August 25th issue, in which I said, erect the pump stay level with bottom of frame. It should be placed 1/16 in. above the bottom, so as to line up the pump barrel with the centre of driving axle in running position. Most builders put it thus. as the position of the screw-holes gave the necessary clue ; but if anybody has put it level with the bottom of the frame, it doesn't matter a bean. As the distance between the eccentric-strap centre, and the eye in the rod is 2 in., the 1/16 in. offset won't affect the working of the pump in the slightest. I just mixed up the pump for " Tich " with one I schemed out for another engine !

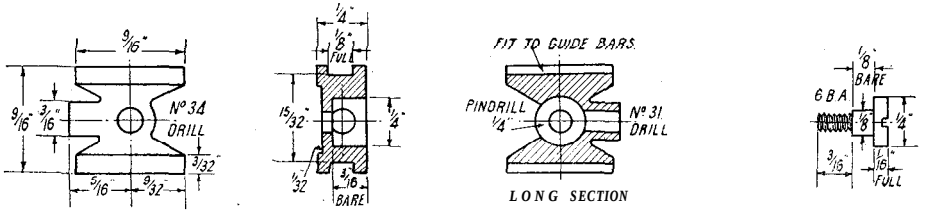
A Wee " Dot " like " Doris "

by " L.B.S.C."

THERE is no need to bother about filing up a posh pair of specially-shaped guide-bars for each cylinder in this small size. The kind shown, look all right, do the job, and are easy enough to make. All you need are four pieces of *3/32-in.* by 1/8in. silver-steel, each *2* in. long. Chuck each truly in the four-jaw, turn down 1/8 in. of one end to *3/32* in. diameter, and screw *3/32 in.* or 7 B.A. to match the tapped hole in the gland boss on the cylinder cover. Then bevel off the outer ends with a file, as shown. Tip to beginners : screw each guide bar into the gland boss ***before filing the*** bevel. If you don't it's a million dollars to a pinch of snuff, that the guide-bar will seat home with the bevel upside down-such is the general cussedness of things in this benighted world-and when you attempt to get the other half-turn? bing goes the ***end*** of the ***screw,*** and you've had it ! Either file the bevels with the bars in place-I have no trouble in gripping the ends of the bars in the bench vice-or mark which is top and bottom, take them out, file the bevel, and replace. If the holes in the bosses have been truly drilled and tapped, and the ends of the bars screwed with the die in the tailstock holder, both bars should be parallel with the piston-rod when fully extended, and the bars screwed home. If not, they will stand a weeny bit of coaxing, but not much ; so watch your step !



Guide bars



Crossheads

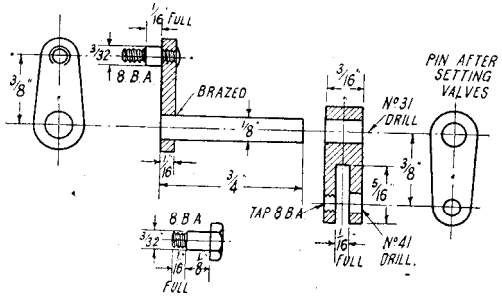
The crossheads differ from the 3-1/2in. gauge size, in being of the single-sided pattern, very easy to make and fit. No need to carve them out of solid steel for a gauge " I " engine. A bit of nickel-bronze (German silver) would do, or ordinary bronze or gunmetal ; it can easily be tinned over, if you are scared of our old friend Inspector Meticulous. A piece of 9/16in. by 1/4in. section, or nearest larger, about 1-3/8in. long, will make the pair of them. The grooves can be end-milled out, same as axleboxes, or cut on a planer or shaper, with a parting-tool a full 1/8 in. wide, in the clapper box. If you set your slide-gauge to the same distance between the jaws, as the guide-bars, the right depth of groove is easily obtained. Cut the grooves each side of the piece of metal first; then chuck truly in four-jaw, turn and drill the bosses, mark off and pin-drill the backs. then saw or part off the piece in the middle, and finish with a three-cornered file, A good way for beginners to drill the bosses, is to mark them in place, using the cylinder cover for a jig. Take off the ***cover,*** put the crosshead between the bars and run it right up to the gland. Hold it there with a toolmaker's cramp, and poke a No. 30 drill through the stuffing-box and gland, making a countersink on the boss of the crosshead. Remove the crosshead, and drill out the ***counter-***sink with No. 31 drill, either on a drilling machine, or by chucking the crosshead in the four-jaw again with the countersink running truly. Don't pin the crossheads to the piston-rods until the connecting-rods have been made and fitted.

Guide Yokes or Motion Brackets

The brackets for supporting the guide-bars may be little castings of the same pattern as used on the 3-1/2in. gauge engine, or cut out of 3/32-in. steel. In the former case they only need cleaning up with a file, and drilling for the screws. Plate brackets may either have the attaching flange bent up from the self-material, or have a bit of angle riveted on. Don't forget you need one right-hand and one lee-hand. The illustration gives the sizes, so no further explanation is necessary. The brackets also are erected after the connecting-rods are fitted, and these form the next job.

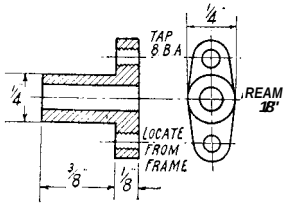
Connecting-rods

The connecting-rods can be milled, or sawn ***and filed,*** from 1/2in. by 1/8in. flat mild-steel, the sizes being shown in the drawing. The little-end doesn't need bushing, though it might be case-hardened, if anybody likes to take the trouble to do it. Just heat to red, roll the eye



Rocking shaft and levers

in any good case-hardening powder, such as " Kasenit," " Pearlite," etc., filling up the hole. Reheat until the yellow flame dies away, then quench in water, and clean up. The big-end should be bushed, as it has to stand the whole driving stress, so drill the hole 3/16 in., and turn up a bush for each rod, from 1/4in. round bronze. This should, when pressed home, stand just proud of the back of the rod ;1/64 in. is plenty. The outside flange should stand out 1/32 in. as shown. There is no real need to drill an oil-hole, but it looks better with one ; also, the driver might go on strike if there is nowhere on the big-end to poke in the spout of his beloved oil-feeder ! Incidentally, if some motorists I know, took the same interest in their oil feeders, and used them as we did, there wouldn't be such a lot of rattling steering-gears, wobbling wheels, and so on ! You don't find any dry pins and bushes under the leading end of my gasoline buggy, or anywhere else on her, if it comes to that. The



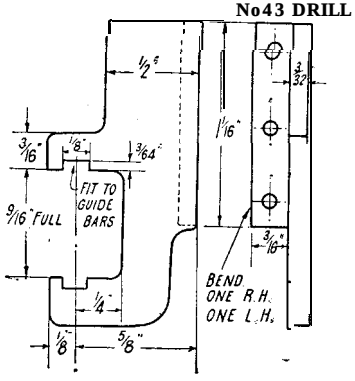
Rocking shaft bearings

garageman down at the end of our road-who, incidentally, owns an " inch-scale " Stirling eight-footer-says that a few more clients like your humble servant, would land him, not in the workshop, but in the workhouse !

The connecting-rods are attached to the cross-heads by special large-headed pins turned up from 1/4in. round steel rod, to the sizes given in the illustration ; this needs. no detailing out. When the guide-bars, crossheads, and connecting-rods are attached to the cylinders, they are ready for erection ; but if you are using the recommended loose eccentric valve gear, wait until the eccentrics are assembled on the driving axle, and the wheels pressed on " for keeps," before attaching them to frames.

Eccentrics and Stop Collars

The eccentric sheaves, or tumblers, are turned from 3/4in. round mild-steel held in the three-jaw ; another simple job. Aim for the smoothest possible finish. The toohnarks will indicate the true centre ; and if a line is scribed across it, what Pat would call the " eccentric centre," and the hole for the stop pin, can be set out on it as shown. Beginners would do well to-chuck the eccentric in the four-jaw, with the pop-mark for the axle hole running truly, and drill and ream with the necessary weapons in the tailstock chuck. The eccentrics only need to wobble up and down, not sideways ! Also, the fit of the sheaves on the axle, should be as close as possible, consistent with freedom to turn. They must not be sloppy ; one of my correspondents had a gauge " I " engine with loose eccentric gear, and "loose" described it exactly. He complained that it kept



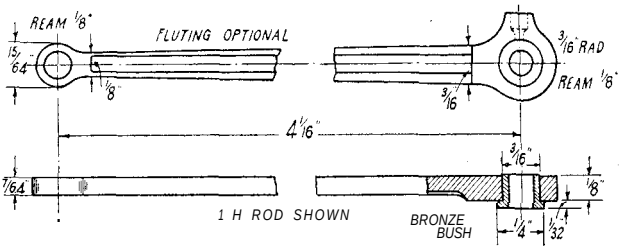
Guide-bar brackets

on " seizing up " when running, and had eased every blessed thing on it that could possibly be eased. I had to grin when I saw it, and stopped the " seizing up " in a few seconds by merely tightening the valve spindle glands ! What was happening was that the motion work was so loose and sloppy, that when the engine was running slowly, as soon as each eccentric passed the top centre, the weight of the tumbler and the strap caused it to fall down in advance of the stop pin, shutting the port and " stopping the clock." The bit of extra friction caused by tightening the spindle glands, was just too much to allow the eccentric to operate the valve without being pushed by the stop collar. The stop pins in the present eccentrics are bits of 3/32in. silver-steel squeezed into No. 43 drill holes.

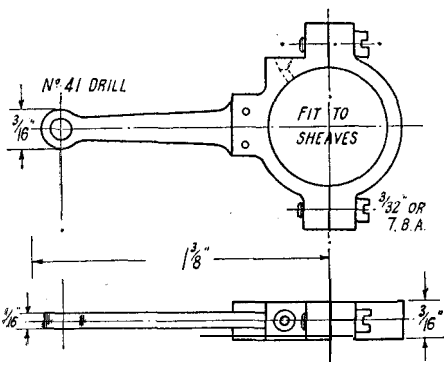
The stop collars are simply 1/4in. slices of 3/4in. rod (brass or steel) with a segment milled, planed, or sawn and filed away as shown. Drill a No. 48 hole in the thick side, and tap 3/32 in. or 7 B.A. for a set-screw. I wonder if those good folk who raise objections to set-screwed eccentrics, stop

collars and so on, know that this has often been done in full-size practice. Many locomotives have their eccentrics set-screwed to the axle, the screws having " cupped points " (says Pat) which are hardened, and when they are screwed home, they bite into the soft steel of the axle so deeply that there is no earthly chance of any movement. The holes into which the heads are sunk, are then filled up with white metal, flush with the rubbing surface of the sheaves, and thus it is also impossible for the set-screws to slack back. I've done the same thing with slotted screw-heads in small eccentrics, and never had one shift yet, all the years I have been locomotive building.

The eccentric straps are castings ; don't forget to saw them across, using vice top as guide, and screw the halves together before boring to fit the tumblers. Here again, they should fit easily



Connecting-rods



Eccentric straps and rods

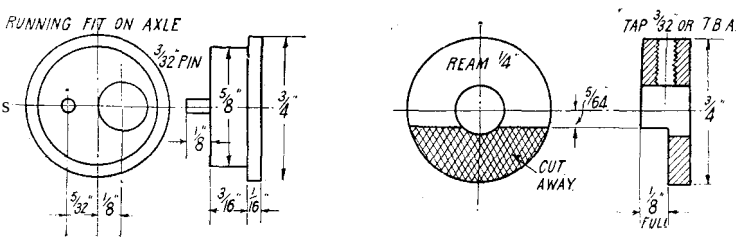
without shake. The rods are filed up from 1/16in. by 5/16in. mild-steel strip, and riveted and soldered into grooves in the lugs on the straps. Bits of domestic blanket pins make nobby rivets for jobs like this ; drill the holes a tight fit for the pins, and countersink both sides. The eyes can be case-hardened if you so desire.

When assembling the eccentrics on the driving axle, note that the flange goes up against the axlebox, and the gap in the stop collar goes over the driving pin ; see plan view of the whole box of tricks. The driving wheels can then be quartered, squeezed home, and the coupling rods erected for keeps."

How to Erect Cylinders

About the easiest way I know for a beginner to erect little cylinders on an engine like this, is to turn a 3/16in. pip about 1/8in. long, on the end of a bit of 1/4in. by 40 rod held in three-jaw. Screw it 3/16in. by 40, and part off about 3/16 in. from the shoulder. Screw this into the exhaust pipe hole in the' cylinder. Attach crosshead and connecting-rod, slide the guide-bar bracket over the bars, and put the whole issue in place against the frame with the brass plug going through the 1/4in. exhaust pipe hole in the frame. Pull the piston-rod out as far as it will go, and line it up with the centre-line of motion. If you haven't got this marked on the frame, don't let that worry you. Get a bit of sewing cotton, stretch it tight, and hold it above the ***centre-line*** of the piston-rod, parallel with it, full length. If the other end of the cotton passes across the centre of the driving axle in running position (3/8 in. from bottom of frame), the cylinder is set O.K. If not, simply adjust the cylinder until you get it right. Then put a toolmaker's cramp over the cylinder and frame, poke a No. 34 drill through the holes in both frames at once, making countersinks on the bolting face ; remove cylinder, drill countersinks No. 44, and tap 6 B.A.

Put a couple of 6-B.A. screws in, to hold cylinder temporarily. Set the guide-bar bracket in position shown in illustrations, and attach it to frame by three 8-B.A. screws. This size is better than 3/32 in. or 7 B.A. for many jobs, as the thread is just as strong, but the heads are smaller ; however, if you haven't any, just make use of what you've got. Now push the piston-rod bang up against the front cylinder cover, and put the crank on front dead centre. The boss of the crosshead will go over the end of the rod. Advance the rod another 1/32 in. into the boss, and pm boss to rod with a bit of 1/16in. silver-steel or 16-gauge spoke wire, squeezed into a No. 52 hole drilled through boss and rod.



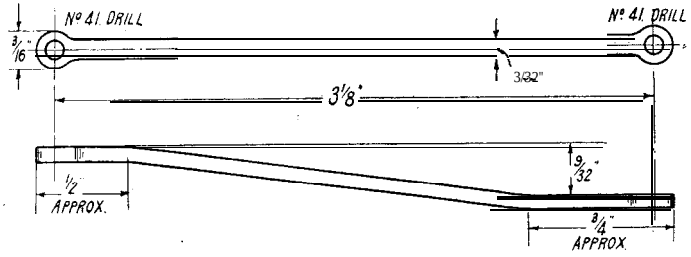
Loose eccentrics and stop

Rocking Shafts for Valve-gear

The movement of the eccentric rod is transmitted " upstairs and outside " by a little rocking shaft with opposed levers ; ***see*** illustrations. The bearings for each of these, fits into the 1/4in. hole in the frames, between the leading coupled and driving wheels. To make one, just chuck a bit of 5/8in. round rod (bronze or gunmetal) in three-jaw, turn down 3/8in. length to 1/4 in. diameter, and part off 1/8 in. from shoulder.

How to Assemble the Valve-gear

There is nothing difficult about assembly and erection. Pin the leading end of the valve-rod to the fork on the spindle, by a bit of 3/32-in. silver-steel turned down each end to 1/16 in., screwed either 1/16 in. or 10-B.A. and furnished with nuts. The back end goes over the pin in the rocker-arm and is nutted, the rocker-shaft being put through the bearing from outside the frame. Put the eye of the eccentric



Valve-rods

Reverse in chuck, centre, drill through with No. 34 drill, and ream 1/8 in. File the flange oval, as shown. At 3/32 in. above and below the 1/4in. hole in frame, drill a No. 43 hole and countersink it. Put the flange in place from inside the frame, and secure with a couple of 8-B.A. countersunk screws, as shown in the cross-section.

The shaft is a 3/4in. length of 1/8in. round silver-steel. The outside lever is filed to shape from any odd bit of 1/16in. steel, the larger end being drilled and reamed a tight fit for the shaft, to which it is brazed or silver-soldered. The small end carries a 3/32-in. pin, screwed in and riveted over at the back. The inner arm is 3/16 in. thick, and is slotted, as shown, to accommodate the eccentric-rod eye. One side of the slot is drilled No. 41, and the other tapped 8 B.A. to take the special pin shown in the drawing ; this can be turned up from a bit of 3/16in. hexagon steel, or the pin may be cheese-headed, just as you fancy. Put a temporary 8-B.A. set-screw in the thick end, to clamp the arm to the shaft whilst valve-setting ; when the valves are O.K. it may be pinned.

Valve-rods

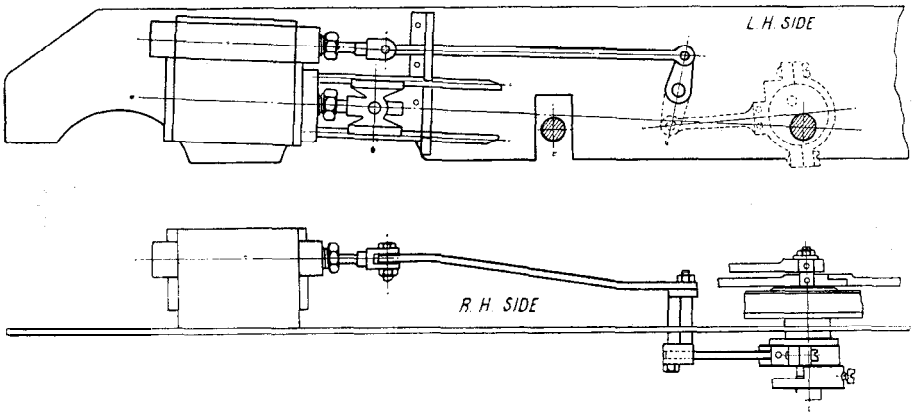
If there's one thing I love to see, more than another, in any little locomotive, it is a valve-gear with straight rods ; but in the present case we can't have a straight valve-rod, because the outside rocking arms can only extend 3/8 in. from the frames, otherwise. the coupling-rods would hit them. The coupling-rods clear the rocking levers by just 1/32 in., which is quite close enough ; but the valve-rods are high enough to miss. They are milled, or sawn and filed, from 3/16in. by 1/16in. mild-steel strip, to the dimensions given in the illustration; note, the length between the pinhole centres should be 3-1/8in. ***after*** the rod has been offset 9/32 in. as shown. If you allow about 1/64 in. extra on the straight rod, it will be all sereny after setting.

rod in the slot in the inside rocker-arm, and secure it with the special screw. This should be done with the arm and eccentric-rod off the engine, so that the end of the screw, which should project a weeny bit, can be slightly burred over, to prevent it coming adrift when the engine is at work. This is necessary, as there is only 1/16 in. of thread to keep the screw in place, and we can't locknut it on account of the flange of the rocker bearing getting in the way. Put the rocker-arm on the end of the shaft inside the frame, and put the strap on the eccentric tumbler, securing it with the screws through the lugs as shown. If the set-screw in the stop collar is tightened, ditto the temporary one in the inside rocking-lever, and the wheels turned by hand, the stop collar should catch the eccentric pin against one of its shoulders, and operate the gear easily and smoothly in either direction of rotation of wheels.

How to Set the Valves

I usually set my valves under pressure, but for beginners and other inexperienced workers, the valves are set easier by sight. Take off the steamchest covers, and turn the wheels by hand. The valve should uncover both ports an equal amount at each end of the movement. If it doesn't, all you do is to move the inside arm on the spindle, one way or the other, until you get equal port openings, and then tighten up the set-screw. For this job, the stop collars may be tightened in any position.

To set valves, put one of the main cranks on front dead centre, with the piston-rod in as far as it will go. Loosen the corresponding stop-collar set-screw, and give it one turn in the forward direction, to make certain it is driving the eccentric properly. Watch the valve closely. Note when it goes as far towards the front of the steam-chest as possible then, as it comes back, look for a black line at the edge of the valve lap,

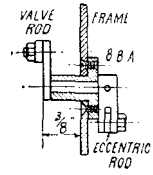


denoting that the front port has just " cracked " as the enginemen would say. Tighten the set-screw in the stop collar, when this state of affairs ***is*** reached ; then ***turn the*** wheels in the forward direction until the back port cracks. If the crank is exactly on back dead centre, the valve is right length, and the setting correct for forward gear. However, if the crank has not reached the dead centre, the valve is too short, and if the crank has passed the centre, it is too long. The first can best be remedied by a fresh valve ; the second, by taking a shade off ***both*** ends, so as to keep the cavity in the exact centre of the valve. This is very important. After shortening, readjust the stop collar, so as to get the valve just cracking each port on the dead centres.

Now turn the wheel backwards, so that the other shoulders of the stop collars engage the pins in the eccentrics, and watch the valve again.

Trial and Error

If the ports crack on each dead centre, as before, the setting is correct for both directions, and the job is done. If the ports crack ***before*** the crank reaches dead centre, take a weeny bit off the stop collar shoulder with a little chisel, home-made from a bit of silver-steel. If the ports do not crack until ***after*** the drank has passed dead centre, make up the stop collar by soldering a little bit of brass to the shoulder. It is merely a question of trial and error. In days gone by, when I was able to do a few jobs for friends, in the way of repairs and overhauls, I sometimes found one opening late ; and easily found out the thickness of packing needed, by putting test strips of different thicknesses between the shoulder of the stop collar and the eccentric pin, like using a feeler gauge. When both front and back ports crack on the corresponding dead centres, when turning the wheels either forward or backward, the valve-gear and setting are O.K., and you can tighten up the set-screws in the stop collars " for keeps." Don't be afraid of them shifting ; because, despite the moans raised about set-screwed eccentrics, I've never had any trouble with them in any engine in my own " running-shed." The gallons of water that set-screwed eccentric-driven pumps have put into the boilers,



Three views, showing arrangement of valve-gear

is just nobody's business ; and I've never had a shifted eccentric in a link motion, or inside Walschaerts gear. Well, that settles the cylinders and motion ; now we want some steam to drive them, and a drop of oil to help them do the job ; so, all being well, the next instalment will deal with boiler, pipe work, and lubricating and firing arrangements.

Rusty Cylinders

Mention above of doing jobs for friends, calls to mind an overhaul I carried out for an old friend just before Hitler lowered the boom, as Pat would remark. The engine had cast-iron cylinders, with pistons and valves made from a special brand of nickel-iron used in automobile work. If our worthy brother who said that he had never seen a properly-rusted cylinder, had seen what I saw when I dismantled the engine, he would have dropped down in a dead faint. The bores were all pitted, and the port faces were very much like a close-up photo of the moon, complete with craters. Had it not been for the fact that special patterns would have been needed, to replace the cylinders, I would have substituted a bronze pair. As it was, I had to machine a full 1/16 in. off the port faces, before getting a smooth surface ; and to prevent repetition of the rusting, I made and fitted separate hard bronze port faces. The cylinders were bored out as big as the castings would allow, and bronze liners fitted. The new valves and pistons were made from a sample of metal something like monel, sent by an American friend. Like " Soplue Tuckshop " of radio fame, the engine is " all right now." I've had plenty of experiences with small cast-iron cylinders-and experience still teaches !

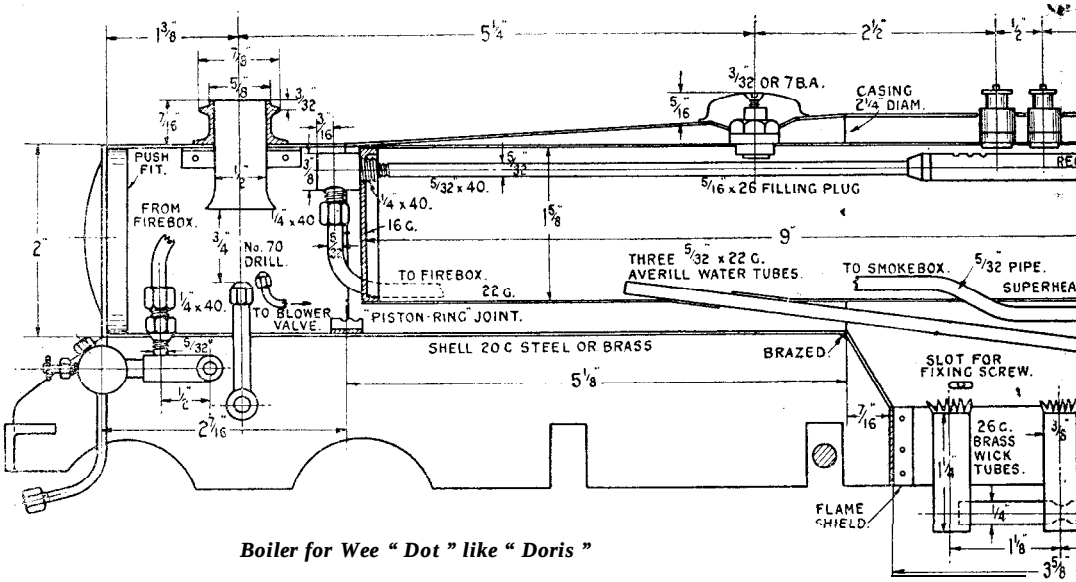
A Wee "Dot"

by " L.B.

BEFORE making and fitting the boiler, we shall need the steam and exhaust-pipes, and the lubricator, so make these the next job. The exhaust-pipe assembly should be fitted first. The centre part of this is a 1/2in. length of 5/16in. square brass rod, drilled 5/32 in. right through, and tapped 3/16in. by 40 ; an easy job in the four-jaw chuck. In the middle of one side, silver-solder an inch of 3/16in. copper tube; screw the end 3/16 in. by 40 and fit a blast nozzle made from 1/4in. hexagon rod, with a 3/32-in. hole in it. The cross pipes are 3/4in. lengths of 3/16in. copper tube, screwed as shown in the illustrauon, and furnished with lock-nuts. Beginners note: to erect, all you do is to screw the cross-pipes into the tee until they touch, place the assembly between the cylinders, in line with the exhaust holes, and screw the pipes out of the tee, into the tapped holes in cylinders, until the short thread is right home at each side ; then tighten the lock-nuts against the tee.

The steam-pipe assembly is on the same principle ; but the tee is horizontal, the steam connection is on top of the stem, and the lubricator at the end, the whole issue forming one unit. The tee may be a casting, or cut from a piece of 1/2in. x 5/16in. brass bar, the unwanted part being sawn away. The head is drilled and tapped right through, 5/32 in. x ***40,*** in the four-jaw ; the stem is drilled up 5/32 in. to meet the cross-hole, and the end tapped 3/16 in. x ***40*** for the lubricator. At 1/2 in. from the centre of the head, silver-solder in a piece of 5/32in. copper tube about 3/8 in. long, screwed 5/32 in. x 40 for half its length. The cross-pipes are made and fitted, same as the cross-pipes for exhaust, except that they are 5/32-in, with smaller lock-nuts-to suit.

The lubricator is a simple displacement affair with a weeny regulating valve. The tank is a piece of 1/2in. copper or brass tube about 22-gauge, with two discs of 18-gauge copper silver-soldered in the ends ; it should just fit between the frames. The valve is made from a 15/16in. length of 3/16in. brass rod, with a valve pin of 3/32-in. rustless steel or bronze, 1/4in. wheel, and 5/32 in. x 40 gland. The filling plug is 3/16 in. x 40, hexagon head, with a bush to match, which is silver-soldered into the tank, above the valve. The drain-pipe for condensate water is just a piece of 1/8in. copper tube long enough to reach to the buffer beam as shown ; valve, bush, and drain pipe are all silver-soldered at one heat. The lubricator is screwed to the stem of the tee, and the whole bag of tricks placed in position as shown. The steam-pipes are run out of the tee into the bosses on the steam-chests, and the lock-nuts run back against the tee ; anoint the threads on the pipes with plumbers' jointing before erecting. A screw run through each frame, into each end of the lubricator, prevents it falling down. If an adaptor is made to suit a motor tyre pump, and temporarily screwed on to the bit of 5/32-in. pipe on top of the tee, the " works " can be tested by air pressure. The wheels should turn equally well in either direction, you can gauge' the power by holding a wheel with your fingers. A vigorous stroke of the pump will probably snatch it away ; whilst if the chassis is placed on the floor, one or two strokes should send it careering across the workshop.



Boiler for Wee " Dot " like " Doris "

' like " Doris "

B.S.C."

Boiler

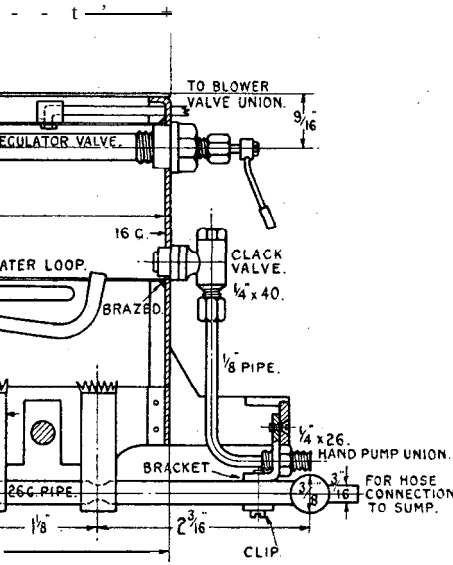
The outer casing of the water-tube boiler is similar to that specified for " Doris," made to the given dimensions. In this little engine, there is no need to slope the firebox wrapper back ; leave it parallel, then one former will do for throatplate and backhead. The best stuff to use for the wrapper would be sheet steel of about ao-gauge ; this doesn't conduct heat away like brass, though the latter can, of course, be used if preferred. The smokebox may be either a bit of 2-in. tube, or rolled up ; doesn't matter which ; it is attached to the boiler case, after the inside barrel has been fitted, by a " piston-ring " joint. The taper part of the boiler is easily rolled up, with a 3/16in. lap seam underneath, secured by a few 1/16in. rivets; no need to braze it unless you wish. The firebox wrapper is bent up as described for " Doris," the throatplate being flanged, and secured by a few rivets. The large end of the barrel is simply placed over the hole cut in the throatplate, and brazed, the joint between throatplate and wrapper being filled in with brazing material same time. The holes for dome and safety-valves are cut, as shown in the illustration.

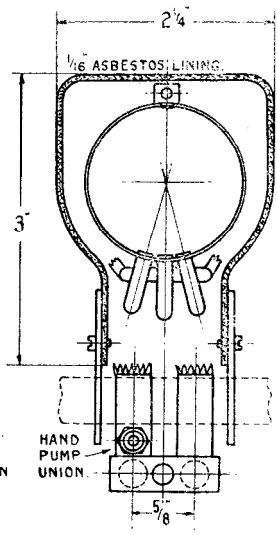
The backhead is knocked up from 16-gauge copper sheet. The inside barrel, which is a 9-in. length of 1-5/8-in. x 22 or 20-gauge seamless copper tube, is brazed to it, the outer end being closed by a brazed-in flanged disc of 16-gauge copper. The three 5/32-in. x 22-gauge water-tubes are put in on the late Mr. T. W. Averill's method, with straight front ends. For beginner's benefit, you just drill the three holes, poke a bit of 5/32-in. steel rod, in each, and force it down to the angle shown for the tubes. This distorts the hole in the barrel, sufficiently for the tubes to be inserted. Note the bends at the rear end are 90 deg. only ; not the acute bends which you see on commercial engines with this type of boiler. Fit the bushes for filling-plug under dome, for safety-valves, and for footplate fittings, then silver-solder tubes and bushes at one heat.

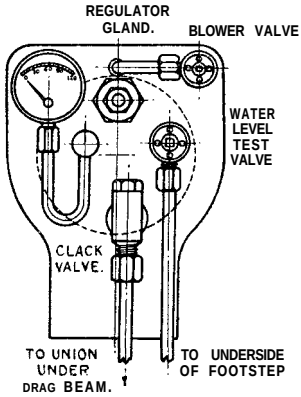
Boiler Fittings

The boiler fittings are cut down to the minimum. In addition to the filling-plug and safety-valves, we need just a regulator, blower, feed-clack, test-cock, and step-gauge. No water gauge is required ; a few strokes of the hand-pump every three or four minutes, will maintain water level. Even if the boiler runs dry, it doesn't matter a bean ; the heat from a " poison-gas plant " cannot hurt a brazed boiler of this type, neither will it hurt if you pump water in, although the pressure-gauge needle will get a bad shock on the first stroke or two ! These tiny boilers will stand more " rough-housing " than big ones.

The regulator is nothing more than a glorified screw-down valve, with a body as long as a Jerry poodle, this being made from a piece of 1/2in. hexagon brass rod measuring 3-5/16 in. long, after both ends have been truly faced. Centre each end, and drill down with No. 30 drill until the holes meet in the middle and form a thorough-fare. Turn down 3 in. length to 5/16 in. diameter ; beginners-and anybody else whose lathe is a bit " off colour " had better do this job between centres. Then further reduce 2-3/4 in. length to

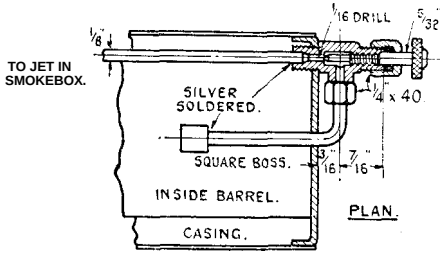




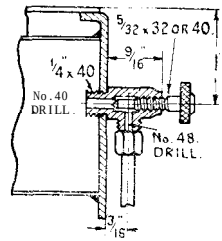


Arrangement of backhead fittings

9/32 in. diameter, and screw the odd 1/4 in. 5/16 in. x 32 or 40. Hold the hexagon end in the three-jaw, and run up the tailstock until the centre point enters the hole in the round end. Then, if you screw the chuck iaws tightly down on the hexagon, and pull the tailstock away, the " dog's body " part should run truly. Open it out to ı in. depth with a 9/64-in. or No. 27 drill, and tap it 3/16 in. Whitwonh ; the coarse thread gives the regulator a quick action. Starting at 7/32 in. from the end, drill three



Blower-valve assembly



Water level test-valve

1/16in. holes close together, as shown., clearing out any burrs by running the tap in again. Hold the barrel part in three-jaw, and turn down the hexagon end to 1/4 in. diameter, screwing for the gland-nut as shown, leaving enough hexagon to form a spanner hold when screwing the regulator into the backhead bush.

Turn up a nipple for the tapped end, from 5/16in. brass rod, as shown ; this must be faced truly at the spigot end, to form the seating for the valve pin. This merchant is made from a bit of 3/16in. rustless steel or bronze rod held in three-jaw. Turn down 5/16 in. length to 1/8 in. diameter, and form a cone point on it ; beginners note that this may be done by a few strokes of a fine file, swept across the end of the rod with the lathe running fast, holding the file at the right angle to suit the cone. Screw the next 5/16 in. length with 3/16in. Whitworth die, and part off. Reverse in chuck, centre, and drill in a little way with 1/8in. drill. Drive a bit of 1/8in. rustless steel or bronze rod into the hole, and silver-solder it. The outer end has a square filed on it for the regulator handle (I have shown L.M.S. pattern, but any kind you fancy will do equally well) and reduce the extreme end to 1/16 in. diameter, screwing 1/16 in. or 10B.A. for retaining nut. The sectional illustration shows how to assemble the whole bag of tricks ; screw a 6-in. length of 5/32-in. copper tube into it, both ends of the tube being threaded, and screw the regulator into a bush, tapped to suit, silver-soldered into the backhead at the position shown, The other end of the pipe should just be showing through a 1/4in. x 40 hole in the plate at the front end.

The front end elbow is a 5/8in. length of 3/8in. brass rod, with a 1/2in. deep hole in it, drilled No. 30 and tapped 5/32 in. x 40 for the steam pipe. The end is reduced to 1/4 in. diameter for 3/16 in. length, and screwed 1/4 in. x 40. A 1/4in. x 40 union nipple is silver-soldered into the side. Put a taste of plumber's jointing on the external thread, and on the steam pipe threads ; then when the elbow is screwed home as shown, there will be no chance of steam leakage The super-heater loop is attached to the nipple by a nut and cone the length of the loop being approxi-mately 22 in. It runs back along one side between boiler and casing, passes between water-tubes and barrel as shown, returns along the other side. and terminates in a swan-neck, which will be attached by a union fitting to the little vertical pipe on the steam tee, when the boiler is erected. The arrangement is shown in the longitudinal section of the boiler.

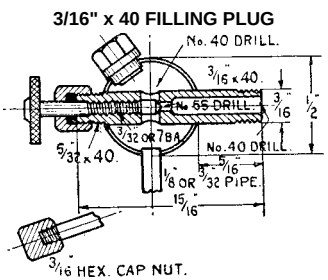
I have described in full detail, how to make screw-down valves, clacks, and other etceteras so many times, that there is no need to go into the whole'rigmarole for this job. Anyway? the illustrations of the backhead fittings are'practncally self-explanatory. The blower-valve takes steam from a connection on the barrel about 1-1/4 in. from the backhead. This is a little block of 1/4in. square brass rod, with a spigot turned on it, to fit a 3/16in. hole drilled in the barrel. Drill a 1/8in. hole in one of the facets, and drill No. 40 through the spigot, to meet the other hole ; then put the block in place. Fit a union nut and cone to a bit of 1/8in. copper tube about 1-3/4 in. long. Drill a No. 30 hole in the backhead just above the barrel ; poke the end of the tube through it, and enter it in the block. Silver-solder the block to the barrel, and the tube to the block, at the same heat ; with the thin metal, a direct appli-cation of the blowlamp flame will do the trick. Make up a blower-valve as illustration, and silver-solder a piece of 1/8in. copper tube into it, about 11 in. long ; the outer end of this should be screwed 5 B.A. Drill and tap a 1/4in. by 40 hole in the top right corner of the backhead ; poke the long pipe through it, and screw the valve home, the nipple on same being set horizontally. Bend the end of the blower pipe around to meet it, and couple up. Fit a weeny nozzle on the outer end, with a No. 70 hole in it, and set it alongside the blast nozzle, so that the jet of steam will blow up the chimney liner. If it won't " stay put," tie it to the blastpipe with a bit of thin wire.

The test-cock is made exactly the same as the blow-down valve specified for my water-gauges, and is shown in section. Screw it into the backhead at I in. from the top, and 1/2 in. to the right of the centre line. A 1/8in. pipe is connected to the valve by a union nut and cone, the outer

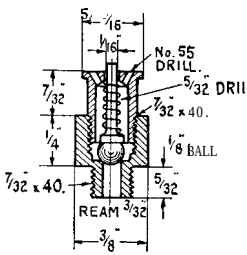
end being taken to some point where you can see it easily : say to the underside of the step, like an injector overflow. When filling the boiler to start from all cold, either pour water in via the filling-plug, or pump it in with the hand-pump in the tender, until water runs out of the pipe. Leave the valve open whilst filling, to let air escape from the boiler.

The steam-gauge fitting is made exactly the same as the blower connection ; but the block may be round instead of square, and screwed into the backhead if you prefer it. The pipe is bent to U-shape ; and the steam gauge, which should be 3/4 in. diameter, reading to 120 lb., is attached to the union as shown. The feed clack is just one of my standard clackboxes, screwed into the backhead as shown ;the 1/8in. pipe from this, goes down through the footplate to the underside of the drag beam, where it is attached to a 1/4in. x 26 union screwed through the upper part of the bracket which holds the feed tubes of the burner in position. The coarser thread gives quicker attachment and far more lasting wear than the usual 40, in this case.

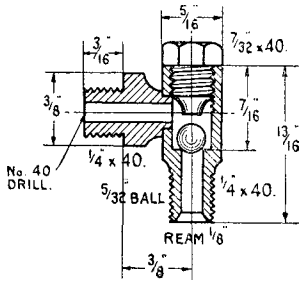
The safety-valves are similar to those I schemed out for a close friend of Inspector Meticulous, who wanted " scale " safety valves on a 2-1/2in. gauge engine. He got the " scale " appearance, though he didn't get " scale " valves! These were large enough to be effective, owing to each valve being housed in the block below the column. In the present case, chuck a piece of 3/8in. bronze or gunmetal rod, face the end. centre. and drill down about 1/2 in. depth with No. 44 drill. Turn down 5/32 in. of the end to 7/32 in. diameter and screw 7/32 in. X 40, part off 1/4 in. from the shoulder. Reverse in chuck, open out the hole to 3/16 in. depth with 3/16in. drill and D-bit, or easier still, use a pin-drill ; tap 7/32 in. X 40, and poke a 3/32-in. parallel reamer through the remnants of the small hole at the bottom. For the nipple, chuck a piece of 5/16in. rod ; face, centre, drill to 1/2 in. depth with No. 50 drill, open out to 5/16 in. depth with 5/32-in. or No. 21 drill, turn down 5/16 in. length to 7/32 in. diameter, screw 1/8 in. length 7/32 in. X 40, and part off at 3/8 in. from the end. Drill four No. 55 holes in the top, pepper-box fashion. The ball, cup and spindle, and spring are fitted, same as I have described for valves of the usual type, and the assembly is shown in the little illustration. The pressure is adjusted by screwing the nipple up or down, as usual. As only the 7/32-in. column projects above the firebox casing, the appearance of the valve is correct.



Lubricator



Safety-valve

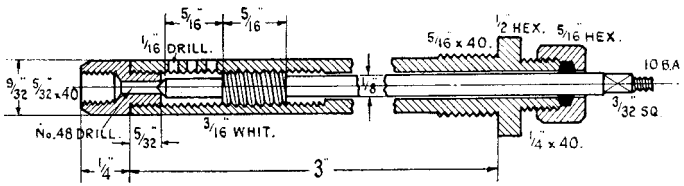


Feed clack

Assembly and Erection of Boiler

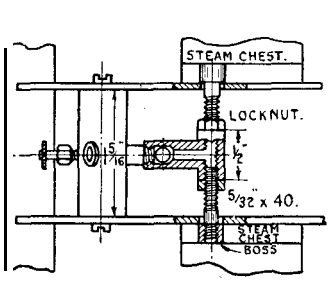
Line the inside of the firebox casing with 1/16in. asbestos millboard. If you damp it, the stuff can be moulded to the casing without breaking ; and a couple of strips of metal about 3/8 in. wide and 2 in. long, one at each side of the lower part of the casing, will keep it in place. They can either be riveted with two 1/16in. rivets in each (one at each end) put through the lot-casing, asbestos, and strip-or screws can be used, nutted inside. The boiler is just slid into the casing, and secured by a few 1/16in. or 10-B.A. screws put through No. 50 holes in the edge of the wrapper, into tapped holes in the backhead flange.

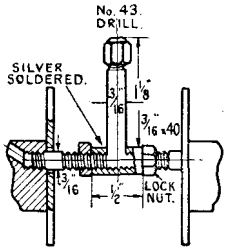
(Right) Details of regulator



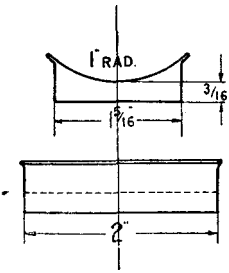
The smokebox saddle may either be *a* little casting, or built up from 18- or 20-gauge sheet metal, to sizes given. You can see where to put it, in the general arrangement drawing published in first instalment ; it is set so that the bottom of the radius is level with top of frame, and fixed with three 1/16in. or 10-B.A. countersunk screws at each side. Drill clearing holes in the bottom of smokebox. for pipes to pass. Place boiler in position, and set it level ; then drill a No. 48 hole at each side of frames. anywhere between the wheels, and tap it 3/32 in: or 7 B.A. Remove boiler, and put a No. 40 drill through the holes in the wrapper ; then elongate them into little slots with a rat-tail tile. Replace boiler, and put screws in ; the slots will allow for expansion of

boiler when hot. To fix the front end down, utilise the steam union. Chuck a bit of 5/16in. hexagon brass rod ; face, centre deeply., and drill down about 1/2 in. depth with No. 30 drill. Turn a bare 1/4 in. length to 1/4 in. diameter, and screw for the union. Part off at 1/2 in. from the end ; reverse in chuck, turn about 3/16 of the end to a taper, and tap the hole 5/32 **x** 40. Screw this on to the end of the bit of tube projecting up from the steam tee into the smokebox, so that the taper fills the hole, and holds the smokebox down ; a bit of plumber's jointing on the threads, and around the taper, will keep it steam-and-air-tight. Put some around the blast-pipe as well. Connect up the end of the superheater loop to the union, and Bob's your uncle. The front of the smokebox is a casting, complete with door and hinges cast on. It is turned to a push fit in the front of the smokebox. The chimney and liner are a half-size edition of those specified for "Doris," and fixed in the same way. The dome casting, after being turned, is attached to the top of the filler screw by a 3/32-in. or 7-B.A. countersunk screw. The complete assembly is shown in the illustration.





Steam and exhaust pipes



Smokebox saddle

Firing Arrangements

The easiest method of firing the boiler is by a six-burner " poison-gas plant," but if your blast and blower are O.K. you'll take all the poison out of the gas ! The burners are six 1-1/4in. lengths of 3/8in. brass tube, not thicker than 26-gauge, or thinner if you can get it. These are mounted on two pieces of 1/4in. tube, also as thin as possible, holes being drilled, or half-round nicks filed, at the points where the feed-pipe passes through the burner. Discs of thin brass close the bottoms, and the whole issue is silver-soldered at one heat for each unit. Both units are silver-soldered to a cross-pipe or drum, made from same stuff as burner tubes, closed at each end ;a short bit of 3/16in. pipe is silver-soldered into the back of the drum, for connection to tender by a rubber hose. A bracket 1in. long is bent up from 13-gauge sheet metal, and attached to the drag-beam by two screws, as shown in the illustration ; a piece of 16-gauge metal, I in. long and 5/16 in. wide, holds the feed tubes to the underside of the bracket, and is itself held up by a solitary 3/32-in. or 7-B.A. screw, passing between the feed pipes and entering a tapped hole in the bracket. Use asbestos string or flock for wicks.

An oil burner may be fitted if desired ; the " axle-dodger " type shown on the blueprint of my oil burners issued from our offices, could be reduced to suit, and would make enough steam to haul a couple of kiddies continuously. There is no need for separate instructions and drawings for the superstructure, as the running-boards, cab, and trimmings are all made like those for " Doris," but to half the given sizes. Now all we need, is a suitable tender ; so I will, all being well, dispose of that in a final instalment.

A Lincoln " Double "

(Continued from page 9)

Rodway were given a trip behind "Bantam Cock," and at the end of his trip Alderman Doughty stated it was one of his greatest thrills.

While the locomotives were being prepared for passenger-carrying, attention was next centred around the race car track, where several fast runs were made ; unfortunately the electrical timing gear had not been completed, so accurate timing was not possible.

Among the cars running were Mr. C. Bunn's 10-c.c. D-type E.R.A., Mr. L. Goodacre's 2.5-C.C. free-lance and Mr. H. Butler's 2.5-C.C. D-type E.R.A.

Unfortunately, rain " stopped play" at tea-time, but in the meantime, well over 300 passengers had been carried.

The multi-gauge locomotive track consists of a 400-ft. oval, comprising two 90-ft. straights and top and bottom curves of 34 ft. radius. Construction is of concrete arches resting on footings cast in position. Arches are of 6-ft. span and are **16** in. in height. Rails are laid in a trough cast in the top of the arches, and consist of 9 ft. lengths of 1-in. x 1/4in. mild-steel bars, held apart by tubular spacers.

The race car track is laid out inside the rail track and consists of a ring of concrete 3 ft. wide, 42 ft. diameter, and is cast in six sections, all correctly reinforced.

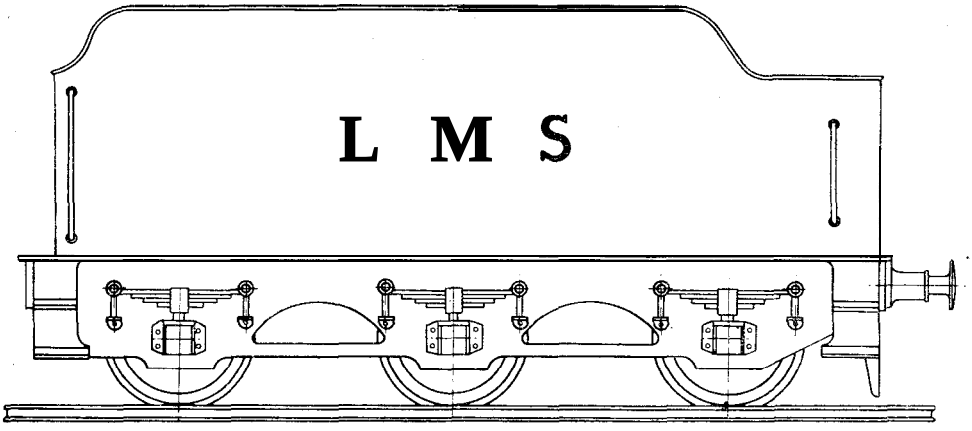
The timing-gear is of the electrical contact type, the contacts being actuated by the centre tether-arm.

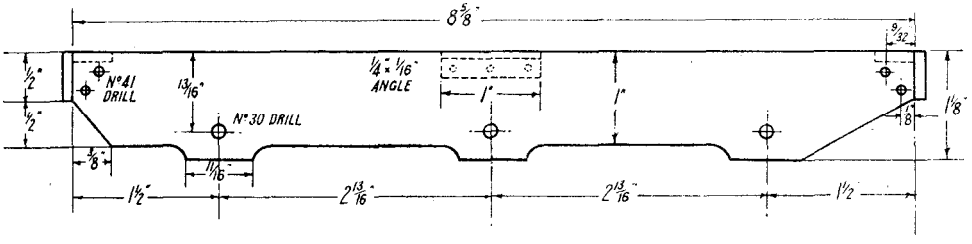
Tender for the Wee "Dot" like "Doris"

by "L.B.S.C."

AS full instructions were given for building the tender for the 3-1/2in. gauge engine, there isn't much to say about the tender for the little one ; but the latter differs a little, inasmuch as there is no coal space, and an extra tank is carried for methylated spirit. If anybody prefers to fit an oil-burner, leave out this tank ; and, all being well, I will give the drawings and a few notes for a suitable oil-burner of the "axle-dodger" type. The tank for this will be circular, and will fit in the space allotted to the "poison-gas" container.

As will be seen from the accompanying outline drawing, the tender differs little in personal appearance from "Doris's" tender, but it is much simpler to build up. The frames can be made from any bits of 16-gauge metal you have handy ; brass, steel, or galvanised iron, will do equally well. No horn slots are needed, the axles running through plain drilled holes in the frame, into blind holes drilled in the axleboxes. There is no need to spring this little tender when the engine is used on an indoor "scenic" railway. Our "approved" advertisers can supply little castings comprising axlebox, horncheeks, spring and hangers all cast as a single unit ; and all they need is a clean-up with a file (a couple of samples received, don't even need that much, being very clean) and the hole drilled for the axle. The easiest way for beginners to do this, is to rivet the casting to the frame, by two 1/16in. rivets through the ends of the dummy spring, taking care to locate the axlebox centrally over the hole in frame ; then poke the No. 30 drill through the hole in the frame, and carry on nearly, but not quite, through the axlebox. An inch of 1/16in. by 1/4in. brass angle is riveted to each side, as extra support for the soleplate, which is screwed down to it.



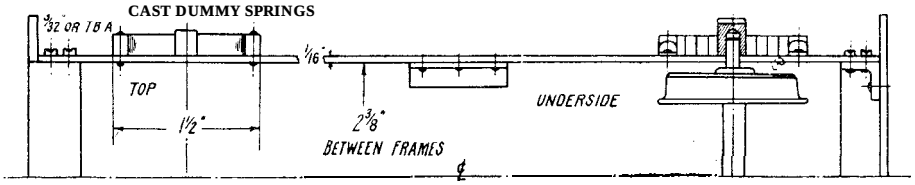


General arrangement. and frame of tender

The drag-beam and buffer-beam are made from 1/2in. by 3/32in. angle, brass or steel. They are drilled and slotted on the vertical faces, same as the engine, but the tops are not slotted, merely cut the corners away as shown, and rivet pieces of angle flush with the edges of the cut-away part. You can't very well braze up this frame assembly,

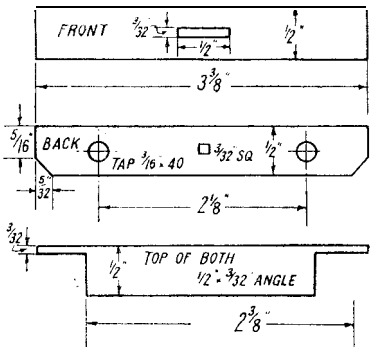
otherwise you won't be able to get the wheels and axles in ; one side of the frame has to be detachable for this purpose. The frames are screwed to the bits of angle as shown in the illustration. Maybe our advertisers would supply cast beams with lugs instead of angles, to which the frames could be screwed.

The wheels and axles are turned, as described for the bigger engine (beginners can follow the

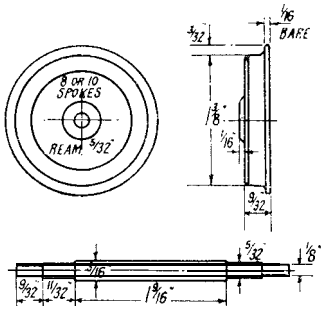


Part plan of frames erected

machining instructions given for "Tich") and, as mentioned above, are put in place when the frames are screwed to the beams. The little chassis thus far constituted, shouldn't rock when placed on the lathe bed or something equally flat and level ; and-hold your breath-it won't collapse if you stand on it ! The true test for a locomotive frame is not to stand on it, but bash it cornerwise against a concrete post or something equally solid. This test won't hurt a frame with angle buffer beams, but it will probably make a lovely rhomboid of one with



***Buffer** and drag beams*



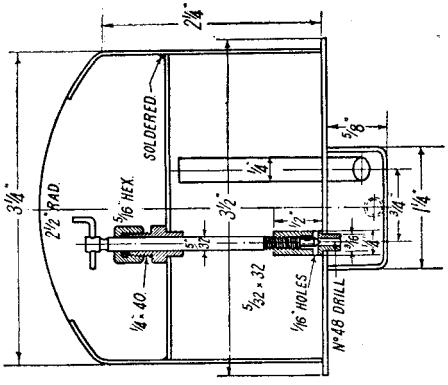
Wheels and axles

plate beams and thin staying. I've seen 'em! If the end wheels touch the flat surface, and the middle ones don't, put a drill a shade larger in the middle bearing holes. This may upset Inspector Meticulous, but it won't affect the running of the tender one iota, and that is all that matters.

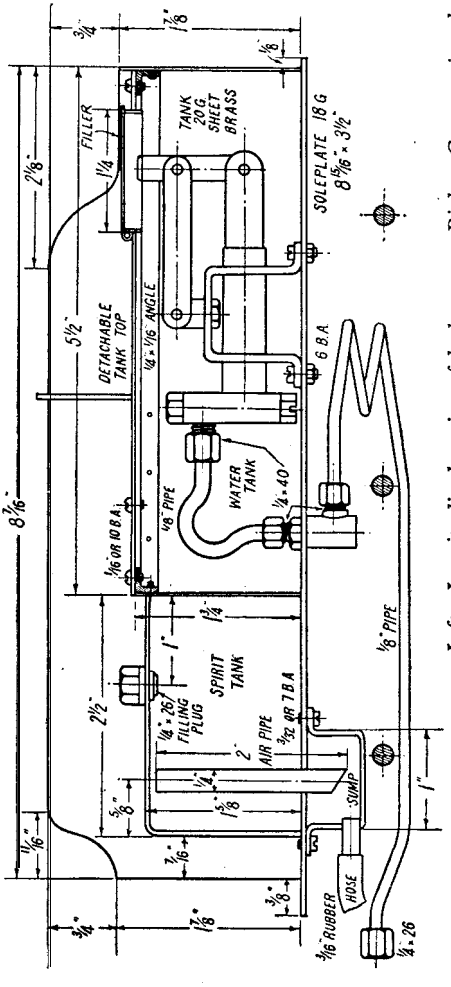
Tender Body

The soleplate is made from 18-gauge brass or copper, and is 8-15/16 in. long by 3-1/2 in. wide. It is attached to the chassis by 3/32-in. or 7-B.A. brass screws through the tops of beams, and side angles, the screws being nutted underneath, as usual. There is no valance on the L.M.S. tenders of this type. The sides and back of the body can be made from a single strip of 20- or 22-gauge brass or copper-hard-rolled brass is the stuff I use-and it may be soldered direct to the soleplate, merely putting a little bit of angle near each front end, and another little bit at the back. No need to rivet or screw them ; just drop in place, solder over the lot, and don't forget to cover the screw-heads. Cut a division plate from the same material as the body, and solder it across the body at 5-1/2 in. from the back end ;this should be 1-3/4 in. high, and a nice fit between the two sides. The space between this plate and the back of the body, forms the water-tank. Rivet a piece of 1/4in. by 1/16in. angle-brass along the top, and along each side and back, as shown in the section, for attaching the removable cover-plate. This is made and fitted as described for the 3-1/2in. engine, and has a filler hole with hinged lid as shown.

The spirit tank is made from a piece of sheet metal, same kind as tender body, 4-1/8 in. long, and just wide enough to fit between the sides. Bend it at right-angles, at 2-1/2 in. from one end ; drill the hole for the filler-plug bush before soldering it in place, then fit the bush and solder that in too. A 2-in. length of 1/4in. thin brass or copper tube, is soldered into a hole drilled in the sole-plate, 3/8 in. off centre line, and 1-3/8 in. from front edge of soleplate ; bevel off the bottom as shown. Level with this, and 3/8 in. off the opposite side of centre line, fit the fuel valve shown in the cross-section of the tank. This is merely a long-stemmed edition of an ordinary screw-down valve, with a valve pin or spindle 2-1/2in. long, made from rustless steel or bronze rod 5/32 in. diameter. The upper end passes through a gland, soldered into the top of the tank. If



Right—Cross section through spirit tank



Left—Longitudinal section of body

beginners drill the hole in the tank top first, with a 3/16in. drill, then carry on through the soleplate, using the hole in the top as guide, the holes will be in line. Open out the top hole to 1/4 in. clearing size ; 7 mm. or 17/64 in. will do, and turn the spigot on the under-side of the gland to suit. Assemble your valve, poke it through the hole in the top, wangle the 3/16in. spigot of the valve itself, through the hole in the soleplate, press the gland body down into the hole in the top, and solder around both. The sump is a little tank bent up from a piece of sheet brass 1-1/4in. wide, leaving a lug or flange at each end for attachment to under-side of soleplate by two screws, as shown in the longitudinal section of the tender body. The sides are cut from the same kind of metal, and soldered in ; a short bit of 3/16in. thin tube is soldered into the front, right at the bottom. When the engine is coupled to the tender, a piece of rubber tube is slipped over this, the other end being attached to the similar bit of pipe on the little cross-drum connecting the burner feed-pipes. Thus the spirit will stand at the same level in the burner tubes, as it does in the sump ; and the little drum will ensure that none of the wicks are starved of fuel. In days gone by, when I had more energy, and could do a little to help friends out of trouble. I fitted several 2-1/2in. gauge engines with this type of feed and burners. The original burners were made entirely of thick copper tube, with feed-tubes far too small ; the consequence was, that when they got hot, the spirit boiled, vaporised, and blew the contents of the feed tubes either back into the tank, or out of the sump, if they had one. The flames then died down until the tubes cooled a little ; then back came the spirit, up went the flames, the tubes heated up again, and the whole process was repeated I tried to explain the cause of the trouble, to the designer, in a friendly sort of way, but he would not take the slightest notice. Such is the way of the world !

Tender Hand-pump

The tender hand-pump is made as described for " Doris " and other engines in this series of notes, but is naturally smaller. There is, of course, no need to keep to the exact type shown ; one of our advertisers, Messrs. A. J. Reeves & Co., supply little castings embodying the base, barrel, and anchor lug on top. All this casting needs, is drilling and reaming for the ram, and drilling for the holding-down screws and the anchor-link pin. A cast valve-box is also supplied, with a projection on the side for turning and pressing into the barrel. The valve-box itself is machined up exactly the same as one made from rod, and assembled exactly the same as one with a bent-up stand, and barrel made from tube.

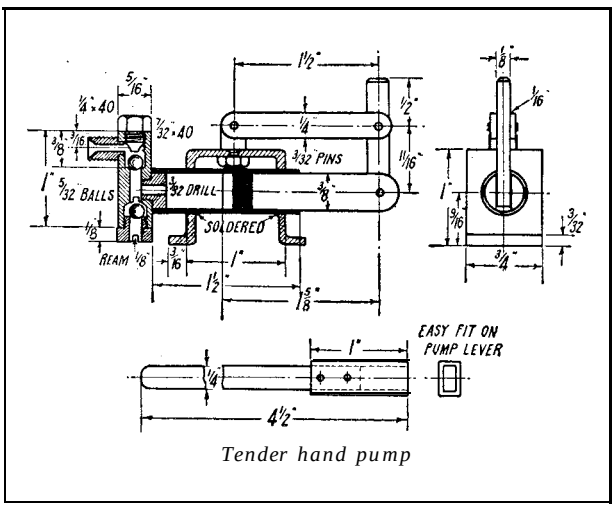
If the built-up job is preferred, the whole bag of tricks is shown in the accompanying illustration. The stand is bent up from a piece of 3/4in. by 3/32-in. brass or copper, with a 7/16in. hole drilled through both sides at 9/16 in. from the bottom. The barrel is a piece of 7/16in. brass treblet tube 1-1/2 in. long ; if the inside isn't perfectly smooth, it can be made so in a very short time, by treatment on an improvised lap. Wrap a few turns of fine emery-cloth

around a wooden meat skewer (if such things haven't become extinct-they are hardly needed for the present size of the meat ration !) or a pencil would do. The roll should be a loose fit in the tube ; grip it in the chuck, run the lathe as fast as possible, and run the tube up and down the improvised lap for half-a-minute or so. The result will be asmooth and true pump barrel. The ram need not be turned at all, if an easy sliding fit in the tube ; all it needs is a packing groove. Slot the end for a 1/4in. lever.

The valve-box is machined up from a 1-in. length of 5/16in. bronze or gun-metal rod-brass will do at a pinch -the sizes being given in the drawing, and the method, the same as described for the larger pumps, and ordinary eccentric-driven pumps. The balls are 5/32-in. diameter, rustless steel or bronze, the delivery seatings being D-bitted 3/16in. and reamed 1/8 in. and the suction seating formed on the bottom cap. The plug for connecting to barrel, *is* screwed into a tapped hole in the side of the valve-box (3/16 in. by 40) and the spigot pressed into the barrel. All joints may be soft-soldered, as there is no heat to withstand, and the solder is only needed to stop up any interstices. It is also quite strong enough to secure the barrel firmly to the stand. The whole assembly is shown in the section, and needs no further explanation.

The complete pump is installed in the water-tank, with the handle exactly under the centre of the filler hole, when the lever is vertical. Fix it down with four 6-B.A. screws through lugs and soleplate, nutted underneath. An elbow fitting, very similar to the one specified for the super-heater, but having the end formed like a union screw, goes through a hole in the soleplate, a little ahead of the valve-box. This is held in position by a lock-nut on the union screw, which should be made about 5/16 in. long for the purpose. The union is connected to the union on the pump, by a swan-neck of 1/8in. tube, with nuts and cones on each end, as shown in the section of the tender body. A 1/8in. pipe, with a couple of coils in it to provide the necessary flexibility between engine and tender, is connected to the elbow union, and terminates under the front beam in a 1/4in. by 26 union nut and cone, for attachment to the union on the engine. The pump is operated by the simple extension h ndle shown, worked through the filler hole ; and the resistance at the end of a 4-1/2in. extension handle, is practically negligible even with 80 lb. pressure in the boiler. I have used similar pumps for test pressures of 350 lb.

Buffers, couplings, steps, and any other trimmings can be " added to taste " as Mrs. Beeton would remark ; and same applies to the engine, so I guess that no further space need be wasted on constructional notes; Instructions for the alternative oil-burner will appear, by kind permission of our friend the K.B.P.. as soon as I can make the necessary drawing. The description of the " wee Dot like Doris " has been very much condensed, as there is hardly need to go into full detail, when I have already fully dealt with the 3-1/2in. gauge engine ; but if any beginner is at all hazy about how to machine and fit the various components, he has only to look up the equivalent part of " Tich." That engine is being very fully and completely detailed out, especially for beginners' benefit ; but-don't laugh too much !-experienced builders of many years' standing have taken a liking to the tiny engine, and many of them are building one to keep her more elaborate and larger sisters company. One advertiser alone, has, at time of writing, sold over four *hundred sets,* and orders are still coming in !



Tender hand pump

Epilogue

Maybe I might do worse than conclude the tale with a hint or two on operation. Oil all the moving parts with any good motor or machine oil, and fill the lubricator about 3/4 full with thick black cylinder oil of " superheater " grade, such as Cyltal 80s, Vacuum 600W, or similar grade. This is essential to protect the valves, faces, and bores from the effect of really hot steam. Fill the boiler with hot water until it runs out of the test-cock pipe ; hot water saves spirit, and gets up steam more quickly. Shut the fuel valve, fill spirit tank about 3/4 full of methylated spirit (what our old friend Bro. " Iron-wire " Alexander, one of the pioneers, used to call " spirits of wine ") screw the filler-cap down tightly, and open the valve. Spirit will flow into the sump until it fills the burner tubes and covers the end of the air-pipe, when the flow will cease, only restarting when the pipe is uncovered, as the spirit is consumed by the burners.

If you have an auxiliary blower, either fan, tyre-pump, or any other kind, use it exactly the same as for a coal-fired engine ; an induced rush of air past the burners, not only gets up steam in double-quick time, but " takes the poison' out of the gas" by eliminating the emission of

(Continued on page 48)

can be machined in the same way as the other vee-grooves in the block. It will be clear that, when the knurled finger-nut is tightened, the central bolt-will be drawn inwards, thus securely clamping the screwdriver blade between the pad-piece and the vee-groove formed in the end of the block ; furthermore, the pad-piece itself can be adjusted to accommodate blades of various diameters.

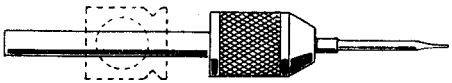


Fig. 9. A chuck used to mount a small blade in the vee-block

Holders for Small Blades

Some small screwdrivers are furnished with detachable blades which are too short to provide the necessary overhang when secured in the vee-block. In this case, as represented in Fig. 9, the blade is mounted in a holder or chuck which, in turn, is clamped in the vee-block ; but a carrier such as the " Eclipse " pin vice will be found less cumbersome for mounting blades up to 3/16 in. in diameter.

An alternative method of holding small round blades is to use an appliance similar to that illustrated in Fig 10. This holder can be made from a length of, say, 5/16in. diameter round mild-steel, and the end of the shank is knurled to afford a better finger-hold. The rod is drilled axially to fit the screwdriver blade, and a piece of steel to carry a binding-screw is silver-soldered to the front end. Whenever carriers, of the forms described, are used for holding small blades, it is important that the blade should overhang the holder for as short a distance as possible in order to maintain rigidity and avoid springing when the tip is being ground.

The Grinding Operation

With regard to the actual grinding operation, when hollow-grinding on the periphery of the wheel is carried out, the screwdriver blade is placed opposite the centre of the wheel and the handle is raised with the right hand until light contact is established ; the left hand, meanwhile, holds the. vee-block firmly down on the guide rail. Grinding should be continued for a few seconds at a time only, otherwise there is a danger of drawing the temper of the blade. Grind first one side of the blade and then the other to keep the tip symmetrical. Examine the faces from time to time, and try the blade in a standard screw slot, or one of a width commonly used, until it is found that a good fit in the screw head has been obtained. If the work has been properly carried out, the hollow-ground faces should appear as smooth continuous curves quite free from ridges or other blemishes.

When grinding the blade with flat faces by using the side of the wheel, the blade is pressed lightly against the wheel for a few seconds and, at the same time, the handle is alternately raised and lowered to keep the work moving. This method of grinding has the disadvantage that the scratch lines formed by the wheel run across the blade and in the direction in which the blade is stressed when in ***use*** ; this renders a hardened tip more prone to fracture than when the grinding lines lie in the direction of the long axis of the blade.

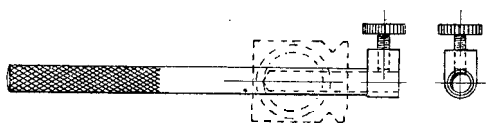


Fig. IO. A holder for small blades

Apart from grinding the sides of the blade, the front face, as the result of wear, may need truing. This can be carried out accurately by withdrawing the blade in the vee-block so that the front edge comes into contact with the wheel and at right-angles to it. To avoid a dig-in, however, it is essential that the blade should be supported close to its tip against the front edge of the table, and, at the same time the screwdriver handle must be held firmly.

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unburnt spirit vapour, which is the stuff that makes your eyes smart. If you haven't a blower, take off the front of the smokebox until there is enough steam to work the engine's own blower ; then open the valve, and replace the front. Warning : keep the blower on a little, all the time the engine is standing, and ***always*** open it before shutting the regulator ; if you don't, flames will come out from under the firebox casing. When there is about 50 lb. on the gauge, give her a run " light," to warm up. Steam will work up to blowing-off point whilst doing this ;then couple up your twenty coaches, kiddy car, or whatever you want the " wee Dot " to pull, and she will oblige, without hesitation. A few strokes of the hand pump every few minutes, will maintain water level. Beginners who have had no experience of loose eccentric valve-gear, should remember that to reverse the engine, it is necessary to move her half-a-turn in the required direction. Once set, she will continue to run that way, until reversed by hand again. The lubricator valve should be opened from half to three-quarters of a turn ; an oily ring at the chimney top is a sure sign that all is well down below. With that, I'll leave you to it